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In the

Supreme Court of the United States.

OCTOBER TERM, 1930.

No. 12, ORIGINAL.

THE STATE OF CONNECTICUT

v.

THE COMMONWEALTH OF MASSACHUSETTS.

MASSACHUSETTS REPLY BRIEF IN OPPOSITION TO CONNECTICUT'S BRIEF IN SUPPORT OF THE EXCEPTIONS TO THE REPORT OF THE SPECIAL MASTER.

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STATEMENT OF ARRANGEMENT OF THIS REPLY BRIEF.

For the convenience of the court the argument herein contained upon the principal brief filed by the State of Connecticut in support of its exceptions is set down under references to the pages of the Connecticut brief to which the argument is pertinent.

DISCUSSION OF CONNECTICUT BRIEF.

Connecticut Brief, p. 4:

The discussion of the pleadings contained in Connecticut's brief should be compared with that found on page 9 *et seq.* in the original Massachusetts brief in opposition to the Connecticut exceptions (hereinafter referred to as the "original Massachusetts brief").

Connecticut Brief, p. 5:

The last paragraph on the page purports to summarize the Massachusetts answer in one particular. A discussion of this paragraph of the answer will be found at pages 151 through 155 of the original Massachusetts brief.

Connecticut Brief, p. 6:

The statement in the last sentence of paragraph numbered 2 on page 6 of the Connecticut brief should be read in connection with paragraph 11 on pages 12 and 13 of the Reprint of the Answer, wherein Massachusetts concedes the binding authority of the Secretary of War and his findings (see also Reprint of Answer, pp. 6, 7, 8, 9).

Connecticut Brief, p. 6:

The summary contained in paragraph numbered 5 on page 6 of the Connecticut brief of certain portions of the Massachusetts answer is misleading. The allegations of the paragraph of the answer, which Connecticut purports to summarize, set up the facts and defenses discussed in the Massachusetts brief at pages 5 to 7, and at page 86 *et seq.* A careful and accurate description of the negotiations between the Metropolitan District Water Supply Commission of Massachusetts and the Secretary of War and the Chief of Engineers will be found at pages 6 to 9 of the

Reprint of the Answer (see also Appendix B, page 81; Appendix C, page 102, Reprint of Answer).

Connecticut Brief, p. 8:

No mention of the reply filed by Connecticut is made in the Statement of Pleadings in the Connecticut brief. This reply is discussed in Massachusetts brief at page 12 and at pages 151 to 155, especially page 153.

Connecticut Brief, p. 8:

Only scant mention of the Special Master's Report is made at this point by Connecticut. A careful outline of this report will be found in Massachusetts brief at pages 7 to 9, 12 to 16, and at 136 to 143.

Connecticut Brief, p. 9:

The first paragraph on this page purports to summarize certain legal contentions of Massachusetts as to the law applicable to this interstate controversy. These contentions of Massachusetts are set out fully in the original Massachusetts brief at pages 98 to 133, especially pages 98 to 114.

Connecticut Brief, p. 10:

It is submitted that the statement in the first paragraph on this page of the Connecticut brief is misleading. A full discussion of the provisions of the statute creating the Metropolitan District Water Supply Commission will be found in the original Massachusetts brief, pages 30 to 41. The statutes themselves are printed at length in the Reprint of Answer, at pages 36 to 80. The interpretation of these statutes made by Connecticut in this paragraph is erroneous (see Massachusetts Brief, pp. 30-41). The language of the statutes, read in the light of their legislative

history, shows that Connecticut is not warranted in trying to stretch the broad powers given to the Metropolitan District Water Supply Commission, to take such water rights as it must inevitably destroy in the execution of the Ware-Swift project, into an authorization to take waters for the purpose of supplying the Metropolitan District about Boston, even from other streams not in any way necessarily involved in the Ware-Swift project. It is perfectly obvious that the Massachusetts Legislature did not authorize the taking of any waters or water rights, except so far as might be necessary in accomplishing the diversion of the waters of the Ware and Swift Rivers, which diversions alone were specifically permitted in the two Acts found in the Reprint of the Answer (pp. 36-80).

Connecticut Brief, p. 12:

The first paragraph under the heading "Navigation" refers to the existence of navigation by pleasure and commercial craft between Hartford and Holyoke. For the one year of which statistics were in evidence, 1928-1929, no commerce was reported between these two points. The only navigation reported was one derrick and forty-six pleasure boats (Joint Sum. p. 49). The only substantial testimony as to navigation between these points was given by Captain Burgi (Joint Sum. p. 48 *et seq.*), who stated that he was the owner of a yacht which he sometimes used as a towboat in the rare instances when it was necessary to take pile drivers, dredges, etc., from Hartford to Springfield. He testified that there was no great volume of navigation between these points.

The third and fourth paragraphs under the heading "Navigation," on page 12 of the Connecticut brief, furnish an instance of the willingness of Connecticut to use *weekly average* figures of stream flow when it suits their convenience, and the stream flow figures for *individual*

days when they are beneficial. The reasons that average figures do not in every instance represent the exact situation to be expected when the Hartford gauge stands at a particular level are discussed fully at pages 49-51 of the original Massachusetts brief. The yardstick adopted by the War Department to determine when a release of additional water from the Swift River Reservoir would be necessary in the interest of navigation was the Sunderland gauge. Various elements enter into the situation, which make it impossible for that gauge accurately to reflect on every occasion the state of the river at Hartford. However, it seems to be the best index now in existence of normal flow conditions of the river. The Chief of Engineers so found in his recommendations as to the Swift River diversions (see Reprint of Answer, p. 97). The following quotation is pertinent: "The discharges of both rivers are affected and regulated to a considerable extent by mill and power dams which temporarily store water to suit occupational uses. The stage of the river at Hartford is indicated by a gauge at that point. The surface elevations are affected by tide and wind. The best information of normal flow conditions of the Connecticut River is afforded by the records of the United States Geological Survey gauge at Sunderland, Massachusetts, located on that river about as far above Hartford as the site of the proposed dam on the Swift River. Study of the gauge records indicates that critical stages normally occur between June 15 and November 15. The critical period for navigation is taken as from June 1 to November 30" (see also subparagraph (*d*) at page 99 of the Reprint of Answer).

Connecticut's exhibit (Exhibit C-41) purports to show that on a number of days in each year, even when the Hartford gauge is at 2.0 feet or less, there will be in fact a diversion instead of an increase in the flow of the river even under the War Department findings. This is to some extent true, merely because an average figure does not repre-

sent necessarily the situation to be found in every given instance. By the same token, however, on a number of days when the Hartford gauge stands above 2.1 feet there will actually be an increase in the flow of the Connecticut River because of the War Department findings. This variation from the average is due to the slight imperfection in the best available standard [the Sunderland gauge] for measuring the need of a discharge from storage on the Swift River. Connecticut was heard fully before the War Department, as the Chief of Engineers stated in his finding (see Reprint of Answer, p. 96, par. 7). Apparently Connecticut engineers were unable to suggest any better index of the need of a release of water from storage than the Sunderland gauge. The comparatively rare occasions in which there is a departure from the average situation are negligible in view of the fact that so many other elements than the Massachusetts project affect the stream flow of the Connecticut River at Hartford. Materially greater changes than those caused by the Massachusetts project might reasonably be expected because of the ponding of water behind the dam of the Northern Connecticut Power Company at Windsor Locks. Various witnesses called by Connecticut stated that the ponding over the week-end caused a very great decrease in the depth of the river (see Joint Sum. pp. 41, 46, 47). Even if a very much more substantial amount of water were to be released from the Swift River Reservoir immediately prior to this week-end ponding, it would have slight effect upon the height of the river at Hartford because of the intervening storage in mill ponds.

In considering the question of the effect of the War Department findings, it should be remembered that only a very small amount of the diversion proposed under the Ware-Swift project takes place during times of even moderately low flow. The testimony of Dr. Winsor, summarized at page 26 of the Joint Summary of the Evidence,

is highly pertinent. He stated "that the flow of the Connecticut River actually diverted by the Ware and Swift project under War Department restrictions averages about 2 percent; (1416) that the average annual flow of the Connecticut River at the Massachusetts-Connecticut state line corresponding to 17,000 cubic feet per second is 542.1 billion cubic feet per year; that the average net annual diversion under Massachusetts legislation as modified by the War Department is 10.8 billion cubic feet per year, corresponding to about 300 cubic feet per second; (1418) that of this 10.8 billion cubic feet, which is the net total annual diversion, 8.1 billion cubic feet, or three-fourths of the total, is taken away when the Hartford gauge reads above elevation 7.4 or 17.4 feet above project channel bottom; that 2.1 billion cubic feet, or nearly one-fifth of the total, is taken away when low tide on the Hartford gauge stands between 3.5 and 7.4 feet; (1419) that in other words, a total of 10.2 out of 10.8 billion cubic feet, or 94 percent of the total diversion, is taken out when low tide on the Hartford gauge stands above elevation 3.5, or 13.5 feet above the project channel bottom, leaving a balance of some six-tenths of a billion cubic feet of the total of 10.8 billion cubic feet, which is taken out when low water on the Hartford gauge is below 3.5 feet; that, however, if at any time low tide is below 2.1 on the Hartford gauge, which corresponds to 12.1 feet above the project channel bottom, the interests of navigation are safeguarded by the release of stored waters from the Swift River Reservoir under the requirements of the War Department, so that the navigable depth is slightly increased at times of lowest flow; (1420) that the amount of stored water which would be released under the War Department requirements, and which will increase the flow in the Connecticut River above what it would have been without any development of the Ware-Swift diversion project, averages about 146 million cubic feet per year, or three

one-hundredths percent of the average annual flow of the Connecticut River at the Massachusetts-Connecticut state line."

The testimony makes it abundantly clear that, on the average and so far as available methods make it possible, the Massachusetts project as modified by the War Department findings is designed to bring about:

1. the taking of as much water as possible from the Ware and Swift Rivers at times of high flow.

2. the taking of no water from the Connecticut River when the Hartford gauge is likely to be below 2.1 on the next day. [The best index of when this is likely to be has been found to be the Sunderland gauge.]

3. the taking of only a trivial proportion of the stream when the Hartford gauge is between 2.1 and 3.5.

4. the release of additional water from storage whenever the Hartford gauge is below 2.1. The inherent infirmity in the law of averages means that 100% perfection cannot be achieved. It is submitted that the variations from average not only will be unimportant, but will be caused by other elements than the Ware-Swift project, such as wind, tide, ponding, etc.

The contentions and arguments of Massachusetts in support of the finding of the Special Master that navigation upon the Connecticut River will not be affected in fact by the proposed Ware-Swift diversion as modified by the War Department findings will be found in the original Massachusetts brief at page 41 *et seq.*

Connecticut Brief, p. 13:

The Massachusetts arguments in support of the Special Master's finding that power on the Connecticut River within Connecticut will not be materially affected by the Massachusetts project will be found at page 63 *et seq.* of the original brief. The Special Master found [Rep. Sp.

M. 20-21, and no exception was taken to his finding] that "no present use of the waters for power purposes will be disturbed" (see Joint Sum. p. 54). The proposed diversion will not affect the *present* plant at all, and any suggestion (in the third whole paragraph on page 13 of the Connecticut brief) that it will is incorrect.

The arguments of Massachusetts with respect to the alleged injury to agriculture, which injury the Special Master found (Rep. Sp. M. 19-20) was not material, will be found at page 57 *et seq.* of the original Massachusetts brief.

Connecticut Brief, p. 14:

The arguments of Massachusetts in support of the Special Master's finding that no substantial decrease or increase of pollution in the Connecticut River will result from the execution of the Massachusetts project will be found at pages 52 *et seq.* and 73 of the original Massachusetts brief. There is no evidence which supports the statement in the Connecticut brief, p. 14, that "during portions of the year it [the river] passes the borderline between being an avowed nuisance and not" (see the discussion, *infra*, p. 33 *et seq.*). As stated in the original Massachusetts brief, the evidence showed that on each day, when Connecticut evidence tended to show that the oxygen content of the river at the Massachusetts-Connecticut state line was approaching its lowest point, there would have been an addition to the total amount of water in the Connecticut River at the state line because of the release of stored water from the Swift River Reservoir, if the Massachusetts project as modified by the War Department findings had been in existence on that day (see Original Massachusetts Brief, pp. 54, 73; see Exhibit D-4).

It is unquestionably true, as the counsel for Connecticut suggest on page 14 of their brief, that the water of the

Connecticut River at Hartford "is so highly polluted that it will be extremely difficult to make it available as a part of the water supply of the metropolitan district of Hartford." This statement is a clear recognition by Connecticut of the great difficulty of treating polluted waters like the Connecticut and Merrimack Rivers so that they will be safe to drink. There is no present project for supplying Hartford with water from the Connecticut River. In fact the undisputed testimony is to the effect that Hartford abandoned the Connecticut River as a source of water supply many years ago because of the danger from pollution (Joint Sum. pp. 88, 263). The only testimony which gave an indication that Hartford would ever consider using the Connecticut River was that of General Wadhams (Joint Sum. p. 146). That testimony was vague, and referred to the indefinite future. Massachusetts makes no contention that a polluted stream like the Connecticut River can or should be made use of for a domestic supply of water in its lower reaches at the present time. For many years all the states along this river have abandoned the main stream to sewage and industrial uses to a very large extent, as the Special Master indicated at page 23 of his report. As conditions change in the future all the states may well be forced into taking new precautions in connection with the disposal of sewage and waste, and the installation of modern sewage and waste treatment plants may possibly be a necessity.

In connection with the statements contained in the paragraph beginning at the bottom of page 14 of Connecticut's brief, reference is made to the arguments in the original Massachusetts brief, at page 56.

Connecticut Brief, p. 15:

The argument of Massachusetts in support of the Special Master's findings that fish life in the Connecticut

River will not be materially injured by the Massachusetts project will be found at page 71 *et seq.* of the original Massachusetts brief. The argument of Massachusetts in support of the Special Master's findings that the supplies of pure and suitable water in Eastern Massachusetts were approaching exhaustion will be found at page 134 *et seq.* of the original Massachusetts brief.

Connecticut Brief, p. 16:

The references to the first four paragraphs on page 16 of the Connecticut brief, to Exhibit C-1, C-2 and C-3, and to the 1922, 1925, and 1895 reports to the Massachusetts Legislature are hardly accurate. These reports refer to various waters in Eastern Massachusetts. With the exception of Exhibit C-2, these reports almost uniformly reject a very large number of waters in Eastern Massachusetts, which they discussed, as obviously unsuitable and unsatisfactory because of objections to the supplies; all of which objections were fully discussed and considered by the Special Master on the basis of evidence introduced before him (see Rep. Sp. M. 32-52). To the extent that Massachusetts in the present case admits that any undeveloped water supplies in Eastern Massachusetts are available, it was shown by the evidence that it is the intention of Massachusetts to develop these supplies fully for communities in the immediate vicinity of the sources thus said to be available (see *infra*, p. 12).

In the second full paragraph on page 16 Connecticut refers to a plan introduced in evidence by an engineering witness called by Massachusetts, providing for a use of the waters of the Merrimack and Ipswich Rivers in combination. This plan was introduced in evidence in a sincere attempt by Massachusetts to show that even a plan which obviated many of the objections to the two plans [discussed by the Special Master in his Report page 32 *et seq.*]

introduced in evidence by Connecticut, was open to such a vast number of objections that Boston and the Metropolitan District should not be obliged to resort to it. The witness who discussed this plan (Mr. Karl R. Kennison, designing engineer, Metropolitan District Water Supply Commission) indicated clearly that he would not consider the use of the Merrimack River unless "the Metropolitan District was *forced* to go to it for additional water" (Joint Sum. p. 244, italics ours). An examination of his testimony from pages 244 to 252 of the Joint Summary shows how unsatisfactory a water supply scheme he regards even this project for utilizing the polluted Eastern Massachusetts supplies. The direct quotation from the evidence, found at pages 252 to 253 of the Joint Summary, clearly reflects his attitude.

Connecticut Brief, p. 17:

The objections to the supplies of water said by Connecticut witnesses to be available in Eastern Massachusetts are fully discussed by the Special Master at pages 32 to 52 of his report. To his findings of *fact* with respect to these objections Connecticut has taken only trivial and inconsequential exceptions, as counsel for Massachusetts have pointed out at pages 143 to 151 of the original Massachusetts brief. These findings of fact, it is submitted, should therefore stand. The gross inferiority of the eastern supplies is so great that this Honorable Court should adopt the view taken by the Special Master.

The suggestion in the second full paragraph on page 17, that Massachusetts concedes that there are two sources of supply in Eastern Massachusetts available which have not yet been developed and which will yield 85 million gallons a day, is somewhat deceptive. These two sources of supply are discussed briefly in the original Massachusetts brief at page 137 *et seq.* and at page 153 *et seq.* They are the ***Assabet River***, where Massachusetts admits that there are

15 million gallons a day available as an *emergency* supply only, by the development of a number of very small watersheds in the headwaters of the Assabet River. The evidence of Mr. Kennison (Joint Sum. p. 251; Transcript, p. 1941) shows that this supply should be regarded only as an emergency supply because of the difficulty of developing the numerous small watersheds, because of the rapidly growing population in the area, which increases the danger of pollution, and because of the fact that approximately 50,000 people outside the Metropolitan District already take their water supply from that area. Similar testimony as to the danger of pollution of the supply because of the encroachment of population was given by Mr. Eddy (Joint Sum. p. 284). To those objections pointed out by Mr. Kennison, Mr. Eddy added the needs of the communities downstream for industrial purposes and for the minimum requirements of diluting even treated sewage and industrial waste (see also testimony of Mr. Goodnough, Joint Sum. pp. 220-221, 222-223).

The principal objection to the immediate use of the *Ipswich River* to supply the Metropolitan District about Boston with water is the fact that of the available 70 million gallons a day of yield from the Ipswich River, according to the agreed statement of water-supply demand in Northeastern Massachusetts by 1970, between 40 and 47 million gallons a day of this yield would be required for communities in the immediate vicinity of the river itself (Joint Sum. p. 159; see figures for "18 towns in Ipswich group"). Indeed it appears that the development of the Ipswich River as a water-supply source for the larger cities in Essex County has already begun. Two cities, Salem and Beverly, already take their supply from that source. Lynn takes a portion of its supply from the Ipswich, and study for further development is now in progress in accordance with the provisions of Massachusetts Resolves of 1927, chapter 30 [see Joint Sum. p. 227]. The Metropolitan

District by that time will be forced to go to other sources. It is obviously highly uneconomical for the Metropolitan District to develop a supply which it would have to surrender to nearby communities in a very short time (see Joint Sum. p. 227, bottom, to 228, middle; see Joint Sum. p. 248, bottom; Joint Sum. pp. 268 to 269). The Ipswich River supply is at best far from satisfactory because the water supply is limited and the quality is poor (Joint Sum. p. 227). The increased population of this area (see Joint Sum. pp. 228, 273, 283), the existence of a peat bottom to the only possible reservoir site (Rep. Sp. M. 52; Joint Sum. pp. 241 to 243; Joint Sum. p. 251, top), which would seriously affect the quality of the water, and the eventual need of abandoning the supply to the nearby communities (see Rep. Sp. M. 38-39, 49; see Joint Sum. p. 251), render this source of supply as a practical matter unavailable for the Metropolitan District about Boston. That district should not be compelled to develop such an uneconomical and temporary supply as a make-shift to postpone the Ware and Swift developments for only a short period of years (Joint Sum. pp. 250 to 251).

The suggestion in the fourth whole paragraph on page 17 of Connecticut's brief, that Massachusetts has permitted its eastern supplies to become polluted, is far from accurate. The Special Master properly found (see Rep. Sp. M. 23, 53 to 54; see page 56 of the Original Massachusetts Brief) that the practice in Massachusetts has not been different from that in all the eastern states. As a matter of fact Massachusetts has made strenuous efforts to clean up many of the eastern streams (see Joint Sum. pp. 220-223, 224-225, 277-278, 284-285). Most of the pollution of the eastern streams is inevitable because of the growth of population in the heavily populated districts in Eastern Massachusetts. So far as the Merrimack River [suggested by Connecticut as a possible source of water supply for Boston] is concerned, the pollution is to a very great ex-

tent outside the control of Massachusetts, because most of the watershed of the Merrimack River lies in New Hampshire. An examination of the Massachusetts exhibit (Exhibit D-20), inserted in the Special Master's Report opposite page 45, will show how true this is (see also Joint Sum. p. 234, and the discussion at pages 45 to 46, and the extract from the testimony of Messrs. Barbour and George Fuller at pages 40 to 44 of the Report of the Special Master).

Connecticut Brief, p. 21:

A full discussion of the acts of the General Court of Massachusetts under which the Metropolitan District Water Supply Commission is proceeding with the Ware-Swift project will be found in the original Massachusetts brief, at pages 43 to 51. The Acts themselves are contained in the Reprint of the Answer, pages 36 to 80. The statement in the last paragraph on page 21 of the Connecticut brief, to the effect that the amount of water taken from the Ware and Swift Rivers will provide the people of Massachusetts 205 million gallons a day, should be read bearing in mind the modification of the Massachusetts Legislation by the War Department findings. The diversion from the Ware and Swift Rivers as permitted by the Secretary of War will be sufficient to provide only 191 million gallons a day (see Rep. Sp. M. 5). This reduction in yield by the War Department findings is of course caused by the fact that the War Department findings require substantial increases in the normal flow of the Connecticut River during dry seasons by releases of water from the Swift River Reservoir. These releases of water already impounded reduce the average yield of the Swift River Reservoir supply to the Metropolitan District by 14 million gallons a day, this quantity being added to the low flows of the Connecticut River. The War Department findings

do not make possible any diversion from the high flows of the Swift and Ware Rivers in excess of that authorized by the Massachusetts Legislation.

Connecticut Brief, p. 27:

Paragraph (3) on page 27 of the Connecticut brief refers to a total capacity of the tunnels leading from the Ware River of 1900 million gallons a day. This total capacity refers only to a capacity to divert water *from the Ware River alone at the same time*, both east to the Wachusett Reservoir and west to the proposed Swift River Reservoir. At any time when these two tunnels were being used to capacity to take flood waters of the Ware River, both east and west, it would be impossible to divert any water from the Swift River Reservoir towards Boston (see Joint Sum. pp. 5-6; see discussion *infra*, pp. 16-19).

Connecticut Brief, pp. 28-29, 32-33:

As indicated in the principal Massachusetts brief (Original Massachusetts Brief, p. 29), Massachusetts contends that evidence as to what may happen thirty to forty years from now in the way of additional water supplies for Boston is immaterial in the present case. The Connecticut argument that the size of the present construction is excessive is, of course, an attempt to show a plan to divert additional water from the Connecticut River watershed in the distant future. The evidence of Dr. Winsor, Chief Engineer of the Metropolitan District Water Supply Commission (see Joint Sum. pp. 6-7), shows that the present construction is highly desirable from the standpoint of utilizing and obtaining all possible water available under the present project. The tunnel, now under construction, both so far as already built and if completed through to the Swift River, will not be large enough, according to Dr. Winsor, to take care of the flow which might be sent

through it under the following circumstances (Joint Sum. p. 6):

(1) When there is as high a flood on the Ware River as might reasonably be expected in the light of the records of floods since 1913, and on other similar watersheds prior to that date (Transcript, pp. 89, 207-208, 691).

(2) When the Wachusett Reservoir is full and it is desired to send Ware River water to the Swift River Reservoir to be stored at times of very high water on the Ware River watershed (Transcript, p. 691).

(3) When the Wachusett Reservoir has been drawn down to a very low point for cleaning or repairs and it is desired to send large quantities of water through the tunnel from the Swift River Reservoir in order to fill the Wachusett Reservoir rapidly (Transcript, p. 691).

(4) During the time when the plan for the temporary diversion of the freshet waters of the East and Middle Branches of the Swift River (see Joint Sum. pp. 6-7) is in force. Inasmuch as there would be no storage back of the temporary diversion dam on the Middle Branch, and as all water taken under the temporary project must be taken when a freshet on the Swift River is in progress, it is necessary to send immediately all water diverted under the temporary scheme through the tunnel to the Wachusett Reservoir. About 18% of the time the tunnel will not be large enough to take care of the water which could be diverted under this temporary project (Joint Sum. p. 7; Transcript, p. 697), particularly because, during the continuance of the temporary diversion, the tunnel from Coldbrook (on the Ware River) to the Wachusett Reservoir would have to carry the flood flows, not only of the Ware River, but also flood flows of the East and Middle Branches of the Swift River, as there would be no storage available for these waters except in the Wachusett Reservoir (Joint Sum. p. 7; Transcript, p. 698 *et seq.*).

After Dr. Winsor's testimony had gone into the case, particularly the testimony with respect to the temporary diversion (see Transcript, p. 697), no further evidence was introduced by Connecticut tending to show that Dr. Winsor's statement was in any respect incorrect, so that statement as to the necessity of having the tunnel the present size must, we submit, stand as uncontradicted in this case, in view of the fact that apparently none of the Connecticut witnesses, who testified before Dr. Winsor, had considered the case of the temporary diversion which will unquestionably affect a material saving in the cost of the Massachusetts project by permitting a postponement of the construction of the Swift River Reservoir (Transcript, p. 1966).

The evidence of Dr. Winsor contained in the Joint Summary of Evidence (Joint Sum. pp. 7-9) shows clearly that so far as the *size* of the proposed Swift River Reservoir is concerned, whatever determination may be made eventually by the Metropolitan District Water Supply Commission will be influenced largely by—

(1) The fact that very great additional size can be obtained for very slight additional expenditure (Joint Sum. pp. 8-9) particularly inasmuch as a very large amount of land, not actually to be flooded, will have to be acquired whatever the elevation of the flow line of the reservoir may be.

(2) The possibility of a greater degree of purification by storage in a large reservoir than in a small one.

In view of the testimony (Joint Sum. pp. 10-11) of Mr. J. Waldo Smith, for many years the guiding genius of the New York Water Supply projects (see Joint Sum. pp. 298, xliv), as to the desirability of large enough structures to ensure flexibility of operation and a conservation of supplies, counsel for Connecticut are hardly warranted in criticizing Massachusetts for making ample provision for a full development of the waters to the diversion of which

from the Ware and Swift Rivers the War Department does not object. This is particularly true in view of the attempt made by counsel for Connecticut to show (see Original Connecticut Brief, pp. 181, 185) that the Wachusett Reservoir (built to supply the Boston Metropolitan District in 1895) had not been made large enough to develop fully the watershed tributary to it.

Connecticut Brief, p. 28:

The power plant at the Wachusett end of the tunnel between Wachusett Reservoir and the Ware and Swift Rivers, referred to in paragraph (7) on page 28 of the Connecticut brief, is of course purely incidental to the primary purpose of the Swift-Ware project. The purpose of this is put very clearly in the original transcript of the evidence by Dr. Winsor. Counsel for Connecticut had been examining Dr. Winsor as to the state of progress of the plans for the development of power from the head of water created by the new tunnel. The Special Master asked the following question (Original Transcript, pp. 200-201):

> "The Master: Whatever you get from the power development, it has the effect of reducing the cost of the water?
>
> "The Witness: It does. It would be foolish for the Metropolitan District to fail to utilize the head of water created by the project so as to reduce the cost of water to the ultimate consumers. The water must travel from the Ware River and the Swift River, which are a considerable height above sea level, down to the City of Boston, which is substantially sea level. Although the water is needed to drink, it can materially develop power in such a way as to affect some saving in the expense of the project."

At page 56 of the Transcript Dr. Winsor said: "the only reason to generate the power is that energy has to be dissipated, and it is an economic way to dissipate it, and there is a market for what power you may be able to generate."

The above comment is, of course, pertinent also to the remarks contained in the Connecticut brief at page 31, paragraph 7 at the bottom of the page (see Transcript, pages 198 to 201).

Connecticut Brief, pp. 33 to 35:

The water supply demand figures, discussed at pages 33 to 35 of the Connecticut brief, are explained fully in the original Massachusetts brief, at pages 136 to 155, especially at pages 136 to 140 and 151 to 155. The Joint Summary of the Evidence, at pages 158 to 160, contains an agreed condensation of the evidence on this subject. The statement at the middle of page 35, that there is no intention to develop the Ipswich and Assabet supplies by Massachusetts, has been discussed above, *supra*, p. 12 *et seq.* While there is no intention to develop these supplies for the Metropolitan District, it is, of course, the intention of Massachusetts engineers to develop them for communities in Northeastern Massachusetts, outside the Metropolitan District, as rapidly as these communities need them. The eighteen towns in the Ipswich group alone will have a demand of 47 million gallons a day by 1970. This will consume a substantial portion of the water yield admittedly available in the Ipswich River valley. The whole of this yield will probably be required for the Essex communities by the year 2000. It is obviously not advisable for the Metropolitan District to develop this source, which it must surrender to nearer communities.

Connecticut Brief, p. 37:

With reference to the table set out at the bottom of page 37 of Connecticut's brief, it should be noted that this table sets out the estimated yield of certain water sources which the witnesses called by *Connecticut* testified was available. The witnesses called by Massachusetts pointed out a large number of objections to these sources, which were considered by the Special Master and are summarized and described by him at pages 32 to 52 of his report. To his findings of fact, as to these objections, Connecticut has taken only minor and trivial exceptions (see Original Massachusetts Brief, pp. 136 to 155).

Connecticut Brief, pp. 38 to 39:

The comment just made with respect to the table at the bottom of page 37 is applicable to the statement with respect to the 379 million gallons a day mentioned at the top of page 39. As to the 85 million gallons a day in the Ipswich and Assabet Rivers, which Massachusetts admits is available but is not developed, adequate comment has already been made (see *supra*, p. 12 *et seq.*).

Connecticut Brief, p. 39:

The heading in italics is not supported by the argument beneath it, and is incorrect (Joint Sum. pp. 276-277).

Connecticut Brief, p. 40:

The necessity of abandoning existing supplies of water in the future has been discussed in a number of places in the Connecticut brief. The undisputed testimony as to the tremendous growth of population in the suburban areas about the Metropolitan District, with the consequent inevitable increase of pollution, makes it abundantly clear why some sources now used in the Metropolitan Area will

have to be abandoned in the comparatively near future (see, for example, the testimony of Mr. Eddy, Joint Summary, pp. 283 to 284; the testimony of Mr. Barbour, Joint Summary, p. 269). It is just such increases of population as this which bring about the tendency toward the abandonment of polluted rivers in favor of pure upland supplies, mentioned by Mr. Barbour in the evidence summarized at page 263 of the Joint Summary.

Connecticut Brief, p. 41:

The quotation on the top of page 41 from Exhibit C-1 should, of course, be read in connection with the legislation in fact enacted in 1926 and 1927, subsequent to the date of the 1922 report. That legislation, as has been pointed out in the original Massachusetts brief, see pages 30 to 39, expressly excluded the Millers River from any diversion and gave no authorization, either express or implied, for any diversion from the Deerfield River.

Similar comment can be made with respect to the first whole paragraph on page 42 of the Connecticut brief.

Connecticut Brief, pp. 43-44:

If the evidence as to the "comprehensiveness of the present works" (now proposed by Massachusetts) was not introduced by Connecticut for "the purpose of anticipating future injury," there could be no conceivable basis for introducing the evidence. The Special Master (Rep. Sp. M. 52-53) properly disregarded the evidence as immaterial, particularly as no suggestion was made by any witness that any additional taking of water for Boston or the Metropolitan District from anywhere would be necessary after the completion of the Ware-Swift project until 1970 (see Joint Summary of Evidence, pp. 13-16). Dr. Winsor stated that a further supply would probably have to be available in 1970, and that the question of where it

should come from ought to be investigated ten to fifteen years earlier (see also Joint Sum. pp. 276-277). Even investigation of a new supply would not start for thirty years.

Connecticut Brief, pp. 46 and 47:

The Connecticut objection to the fact that the Massachusetts legislation authorizing a diversion from the Ware River refers to that diversion as "a diversion of flood waters" has been discussed fully at page 16 of the Massachusetts brief.

Connecticut Brief, p. 49:

The War Department findings with respect to the Ware and Swift diversions are discussed at length in the original Massachusetts brief at page 86 *et seq.* (see *supra*, p. 15).

The difference of 14 million gallons a day in *net average water supply yield* to Massachusetts from the project, as originally planned, and as modified by the War Department findings, is due almost entirely to the requirement of the Secretary of War that Massachusetts, during periods of low flow, make releases from waters impounded from the Swift River during high flows. So substantial is this low flow release that it reduces the net average yield of the project by the 14 million gallons a day, referred to in the first paragraph on page 49 of the original Connecticut brief. The Secretary of War finds that the diversions from the Swift and Ware Rivers at times when the Connecticut River at Hartford stands above 2.0 on the Hartford gauge will have no adverse effect upon the navigable capacity of the river (see Reprint of Answer, pp. 99-100).

The suggestion contained in the Connecticut brief, in the paragraph beginning at the bottom of page 49, has been discussed in the original Massachusetts brief, at pages 39 to 41.

Connecticut Brief, p. 51:

The statement in the last paragraph on page 51, as to the contention of Massachusetts with respect to the jurisdiction of the War Department, is absolutely unfounded. The position of Massachusetts is set out in the Reprint of the Answer at pages 6 to 9, especially in subparagraphs 5 (*a*), (*b*), and (*c*) on pages 6 to 7:

> "(*a*) that no . . . permit from Congress, the War Department, the Secretary of War, or the Chief of Engineers is necessary for the erection of any structures as such in a non-navigable river or stream.
>
> "(*b*) that the United States Government, the War Department thereof, the Secretary of War, and the Chief of Engineers have jurisdiction over the diversion of waters from non-navigable tributaries of navigable streams solely because such a diversion may result in the obstruction of the navigable capacity of a navigable stream into which such non-navigable stream may flow.
>
> "(*c*) that it is the duty of the Secretary of War and the Chief of Engineers to grant a permit for a diversion from a non-navigable stream, unless such diversion will result in an unreasonable obstruction of a navigable stream or will unreasonably alter or modify the capacity of the channel of a navigable water of the United States."

Connecticut Brief, p. 52:

The statement at the top of page 52, that Massachusetts has not accepted the recommendations of the War Department and that the Metropolitan District Water Supply Commission has not acted upon them, is directly contrary, not only to the statements of counsel for Massachusetts during the case, but also to the testimony of Dr.

Winsor, Chief Engineer of the Metropolitan District Water Supply Commission, summarized at page 25 of the Joint Summary of Evidence. This testimony was to the effect that the "Metropolitan District Water Supply Commission plans are being made in compliance with the War Department decision; that he is not intending to go beyond the requirements of the War Department." That Massachusetts is bound by the War Department requirements is, of course, fundamental (see argument Original Massachusetts Brief, pages 39-41).

Connecticut Brief, p. 53:

The argument of Connecticut, based upon figures of daily stream flow, discussed briefly by counsel for Connecticut at page 12 of their brief, and already commented upon in this brief (*supra*, p. 4 *et seq.*), is repeated by counsel for Connecticut at page 53 of their brief (see Original Massachusetts Brief, pp. 41-51, especially pp. 50-51).

Connecticut Brief, p. 56:

The findings of the War Department have only a very slight effect in modifying the amount of diversion by Massachusetts during periods of high flows on the Connecticut River and on the Swift and Ware Rivers. The floods usually occur during the spring or in the late fall, and so the time restriction preventing any diversion at any time from the Ware River during the period from June 15 to October 15 is not generally applicable. The War Department was interested solely in protecting the very low stages of the river from material reduction in height. Even during very high flows, the reduction in the height of the river, due to the Massachusetts project, would have reached as much as 6 inches (according to Complainant's Exhibits C-6, C-6A, and C-6B), only on two days during the period of sixteen years of which adequate stream flow statis-

tics are available. At times when the Hartford gauge stands at between 17 and 25 feet, the reduction in flow due to the Massachusetts project, as shown by these exhibits, probably would not average in excess of 4 inches.

Connecticut Brief, p. 61:

See discussion in the original Massachusetts brief, at pages 98 to 133.

Connecticut Brief, p. 62:

See discussion in original Massachusetts brief, at pages 121 to 133.

Connecticut Brief, p. 63:

With respect to the law which this Honorable Court has said is applicable in interstate cases, like the case at bar, see the original Massachusetts brief, at pages 98 to 121, especially 99 to 114.

Connecticut Brief, p. 64:

The statement (in the third whole paragraph on page 64 of the Connecticut brief) that Kansas recognized the "appropriation" theory of water rights is incorrect. This Court in *Kansas* v. *Colorado*, 206 U.S. 46, at page 103, relied heavily on the decision of *Clark* v. *Allman*, 71 Kan. 206, citing and quoting *Elliot* v. *Fitchburg R.R.*, 10 Cush. 191, at length, and applying in Kansas substantially the Massachusetts rule of water rights.

Connecticut Brief, p. 82:

The comments on the War Department findings on the first whole paragraph on page 82 of the Connecticut brief, based upon the use of figures for particular days, instead of weekly averages, should be considered in the light of

the argument contained in this brief (*supra*, p. 4). The same material should be considered in connection with the misleading statement that water is to be released from the Swift River Reservoir only when the Hartford gauge is at 2.1 feet or lower. This incorrect statement is found at the bottom of page 84, at the end of the top paragraph at page 85, and in the first whole paragraphs on pages 86 and 87 of the Connecticut brief.

Connecticut Brief, p. 83:

The argument on the facts as to the navigable capacity of the Connecticut River is answered in the original Massachusetts brief at page 41 *et seq.*

Connecticut Brief, p. 87:

The Connecticut contention based upon the *structures* which Massachusetts proposes to erect in the non-navigable Swift and Ware Rivers, is fully answered in the original Massachusetts brief at pages 90 to 92. It is submitted that the argument on the law beginning at page 92 of the Connecticut brief is fully answered by the argument contained at pages 74 to 98 of the original Massachusetts brief.

Connecticut Brief, p. 110:

As to the argument contained in the first paragraph on this page, see the original Massachusetts brief, at pages 40, 83, and 84. As to the Connecticut contention contained in the paragraph beginning at the bottom of page 110, see original Massachusetts brief, pages 77 to 84.

Connecticut Brief, p. 111:

The contention contained in the first paragraph on this page is discussed in original Massachusetts brief, pages 90 to 92.

Connecticut Brief, p. 112:

The interpretation of section 10 of the River and Harbors Act of 1899 is discussed in the original Massachusetts brief, pages 77 to 84.

Connecticut Brief, p. 115:

See original Massachusetts brief, page 90 *et seq.*

Connecticut Brief, pp. 117, 119:

Massachusetts makes no contention that rights, other than those affecting the public interest in navigation, are concluded by the War Department findings (see Original Massachusetts Brief, pages 97-98). It has been argued (Original Massachusetts Brief, page 41 *et seq.*) and the Special Master has found (Rep. Sp. M. 12, through 19), that the proposed diversion will not injure navigation in fact.

Connecticut Brief, p. 125:

The Connecticut argument on page 125, directed against Professor Weston Fuller's testimony, with respect to the value of the low flow releases from the proposed Swift River Reservoir to the proposed power redevelopment at King's Island, should be answered briefly. Mr. Jacobs testified (Joint Summary, p. 54) that the method of the developing of the proposed King's Island power project would be to build a dam further down the river than the present dam, thereby increasing not only the head of water, but, of course, the amount of water available in the pond behind the dam. The value of pondage for the purpose of storing water over the week-ends in times of low flow was testified to (Joint Sum. pp. 254-257) in most striking terms by Mr. Uhl, a consulting engineer of broad experience (see Joint Summary, p. xlvi). In water power

matters the purpose of pondage is, of course, to enable the concentration of a maximum amount of flow into the hours when it is most valuable. It is hard to see how any reasonable prudent business man could possibly undertake a water power development of the size of the suggested King's Island development unless a very considerable pondage was in fact available.

There is nothing in the evidence to indicate that Professor Fuller's assumption (quoted at the bottom of page 24 of the Connecticut brief), that sufficient pondage will be available to allow the drawing of water at high rate, is not correct.

A special instance, noted in the Connecticut brief, in the paragraph beginning at the bottom of page 125, is somewhat misleading. Though the records show that, on one day, November 18, 1924, there would have been a variation from the average situation to be expected under the War Department findings, none-the-less, during the whole week in which that day occurred, there would have been an average increase of 3 cubic feet per second due to releases from the Swift River Reservoir; during the previous week there would have been an average increase of 40 cubic feet per second due to release from the Swift River Reservoir. The effect of this average increase in the low flow of the river, due to the releases from the Swift River Reservoir, would, we submit, have been of advantage to the power company because they would have had more water available to store in the pond. [The Massachusetts project which, of course, was not in effect in November, 1924.]

The necessity of taking into account average figures over a short period of time, such as a week, rather than figures for individual days, has already been discussed in this reply brief (*supra*, p. 4).

Connecticut Brief, p. 130:

A casual reading of the first full paragraph on page 130 of the Connecticut brief would lead one to believe that the damage to power of $80,000, found by the Special Master (Rep. Sp. M. 21), was a recurring damage, amounting to that sum in each year. This, of course, is not true. The sum of $80,000 represented the capitalized (at 5%) average annual damage to power of $7900, adjusted for the credit representing the saving in capital investment due to the additional water at times of low flows (because of the releases from the Swift River Reservoir required under the War Department findings) [see Original Massachusetts Brief, p. 63 *et seq.*].

Connecticut Brief, p. 131:

The argument of Massachusetts in support of the findings of the Special Master, that agriculture in Connecticut will not be seriously affected by the Massachusetts project, will be found at page 57 *et seq.* of the original Massachusetts brief. Upon the conflicting evidence produced by Connecticut from her own witnesses, the Special Master has found that no substantial amount of injury will result from the comparatively trivial diversion of flood waters called for by the Massachusetts project (see Rep. Sp. M. 19-20). Assuming that, in a very small flood [the Hartford gauge standing at 17], when there would be at least 25 feet of water in the river (Joint Sum. pp. 23-24, see p. 76), the Massachusetts project reduced the depth of the river 4 inches (see Exhibit C-6, C-6A, C-6B), it would reduce the depth of the river at Hartford only slightly over 1% [4 inches out of 300 (25 feet)].

Connecticut Brief, pp. 136-137:

Although upon the evidence there can be no doubt that the spring floods do some benefit to the Connecticut hay

lands actually flooded, there was no convincing evidence tending to show that any substantial amount of land would not be flooded at all as the result of the Massachusetts project. The missing link in the chain of Connecticut's proof on this point is the complete absence of any reliable evidence showing that the diversion under the Massachusetts project of a portion of the very high floods would result in any material decrease in the amount of land actually submerged.

Connecticut Brief, p. 138:

It is submitted that counsel for Connecticut are endeavoring to push the quotation from *Georgia* v. *Tennessee Copper Co.* (206 U.S. 230, 237) to an unwarranted extreme. That case involved a suit by a *quasi*-sovereign state against a private corporation doing business in another state. It was not in any sense a pure interstate case like *Kansas* v. *Colorado*, reported in the same volume of the United States reports (206 U.S. 46). It is contended that this Honorable Court has laid down, not only in *Kansas* v. *Colorado* but in other similar cases [see the Original Massachusetts Brief, at page 106 *et seq.*], as the rule applicable to interstate cases like the case at bar, the doctrine of "equality of right" or equitable division. It is submitted that the rights of one *quasi*-sovereign state in an interstate stream are to be construed with reference to the equal and corresponding rights of all other *quasi*-sovereign states through which that stream passes. It is only reasonable, in territory like the New England states, where there are many congested urban areas, that each state interested in an interstate stream should be entitled under present circumstances to use a reasonable proportion of the waters of that stream for a domestic water supply in whatever portion of the state it desires, so long as it does not so substantially diminish the volume of flow of the river as

to make it impossible for other states further downstream to make a similar use of a portion of the remaining waters (see Original Massachusetts Brief, pp. 149-150).

Connecticut Brief, p. 140:

The arguments of Massachusetts in support of the finding of the Special Master, that the decrease or increase of the pollution of the Connecticut River due to the Massachusetts project would not be material, will be found in the original Massachusetts brief, at pages 52 to 57.

The statement in the first paragraph, under the heading "Pollution," on page 140 of the Connecticut brief, to the effect that "the quantity of domestic sewage and industrial waste which can be assimilated safely by any stream is in direct proportion to the percentage of dissolved oxygen in that stream," is highly misleading. Two principal elements must be taken into account in determining the capacity of any stream to assimilate sewage at any given point on the stream. These are (1) the dissolved oxygen present in the stream at the point in question, which represents a capacity to dissolve sewage; (2) the oxygen obtainable from the air and from tributaries by the stream in its progress to the sea from the point in question through re-aeration. The process of re-aeration on the Connecticut River is discussed at pages 54 to 55 of the original Massachusetts brief. Exhibit D-15, quoted at length (*infra*, p. 41), shows that during the very dry month of August, 1929, the Connecticut River at the state line had a population capacity [see, for definition of term "population capacity," Original Massachusetts Brief, pp. 52-53] to take care of the sewage of 368,000 people in addition to the people and industrial plants furnishing the sewage and wastes, of which the river was already taking care satisfactorily. By the time the river had reached Rocky Hill, below Hartford, and had received the whole sewage of the City of Hartford (because of the process of re-aeration), the ca-

pacity to dispose of additional sewage and wastes had increased to an ability to take care of the sewage of 816,000 more people than were then contributing sewage to the river. Re-aeration therefore is a potent factor which must be considered. It is neglected entirely in the first whole paragraph under the heading "Pollution" on page 140 of Connecticut's brief.

Connecticut Brief, p. 142:

At the bottom of the page reference is made to Dr. Winslow's testimony (Joint Sum. p. 92) to the effect that the Connecticut River at the state line, in the autumn of a fairly average year, is on the border line of nuisance. Dr. Winslow defines what he means by "border line" in his testimony, summarized at page 89 of the Joint Summary of the Evidence. In speaking about the first ten days of September, 1929 [when incidentally, if the Massachusetts project had been in effect, water would have been released from storage in the Swift River Reservoir, increasing the flow of the Connecticut River at the state line, see Exhibit D-4], Dr. Winslow says ". . . certainly *any substantial removal of oxygen* above that present [in the river] would during a period such as this have pushed the thing over the line, exhausted the oxygen completely and produced a real nuisance." More specifically (Joint Sum. p. 89, middle), he says that the river "during that ten days was in a border line condition and *any substantial removal of oxygen or water containing oxygen* would have thrown it completely over the line." (Italics ours.) It is apparent that in order to change present conditions so as to produce a nuisance there must be in Dr. Winslow's opinion what he calls "substantial removal of oxygen or water containing oxygen." What he calls a "substantial" removal of water containing oxygen is shown by the evidence quoted at page 90 of the Joint Summary of the Evidence and at pages 24

to 26 of the Report of the Special Master. Dr. Winslow, in the passage there quoted, certainly does not regard anything less than a 10% diversion as important.

It is also significant that Dr. Winslow refers to the Connecticut River at the state line as being on the border line of a nuisance in the "*autumn of a fairly average year*" (Joint Sum. p. 92). He bases these conclusions on the border line of nuisance on observations taken by him and by Dr. Rudolfs in the summer and fall of 1929, especially the first ten days of September. It is submitted that the summer of 1929 was an unusually dry period. It was not an "average" summer. From Exhibit D-36 one can obtain the number of days in 1929 and the average of seventeen years when the Hartford gauge stood at 2.0 feet or less at lower low tide. The figures for the year 1929 and the average for the seventeen-year period shown on this exhibit are as follows:

NUMBER OF DAYS WHEN THE HARTFORD GAUGE STOOD AT 2.0 OR LESS.

	1929	Average of 17 years
July	14	10.7
August	29	15.8
September	27	16.7
October	27	11.3
November	20	6.7
Total number of days	117	61.2

While it may be true that the total amount of water which flowed in the Connecticut River during the year 1929 "was very slightly below the average" (see Exhibit D-4), the period July to November, during which the Connecticut analyses were made, could hardly be considered slightly below the average dryness when the records show that the Hartford gauge recorded 2.0 feet or less on 117 days, as compared with the seventeen-year average of the

same period of the year of 61.2, an excess of 91% over the average.

On page 143, the second whole paragraph, the reference to 1929 as slightly below the average here appears expressly. It is submitted that our contentions above show Connecticut's statement to be incorrect. Incidentally during 1929 Exhibit D-4 shows that there would have been average weekly additions to the flow of the Connecticut River during that summer continuously from July 22, 1929, through and including the week beginning October 14, 1929. This period covers each of the individual days mentioned in the second whole paragraph on page 143, on which the Connecticut analyses found low figures of oxygen saturation. Had the Massachusetts project been in effect, the oxygen saturation would have been increased because of the discharge of additional water from the Swift River Reservoir in accordance with the War Department findings, although, as Dr. Winslow testified (Joint Sum. p. 90), it would probably have been impossible to detect the difference due to these increases or to diversion of a similar amount had it taken place by any methods of scientific analyses now known. The comments above (*supra*, p. 33) made as to what Dr. Winslow terms "border line of nuisance" are also applicable to the last paragraph of page 143 of Connecticut's brief.

Connecticut Brief, p. 144:

In view of the evidence of Dr. Winslow (quoted *supra*, p. 33, in the Report of the Special Master, pages 24 to 28, and contained in the Joint Summary of the Evidence between pages 89 and 95), it is submitted that the Special Master was clearly right in finding that the Massachusetts project as modified by the War Department findings will not in any important way either decrease or increase the pollution of the Connecticut River. The case at bar is not a case brought to abate pollution of the Connecticut

River. If it were, Connecticut would not come into court with clean hands (Rep. Sp. M. 23). There is no evidence that the stream has now become a nuisance, and, as we have shown above (*supra*, p. 34), even Connecticut witnesses testified that it will take at least a 10% diversion, even in very dry periods, to be detected.

Connecticut Brief, p. 145:

The second paragraph of page 145 of the Connecticut brief gives rise to an inference that Connecticut made observations daily and that Massachusetts made observations only once a month. As a matter of fact the Massachusetts monthly averages were compiled from samples taken in the following way: The observers employed by the Metropolitan District Water Supply Commission took samples on five days out of seven during the period from the latter part of September, 1928, to the close of navigation on December 17, 1928, and again from the time the ice went out in the early spring of 1929 until November, 1929, and during the balance of the time once or twice a week. Whereas Connecticut took samples daily during brief periods in 1928 and 1929, their work in general was confined to one sampling a day at each station, whereas Massachusetts sampling consisted of taking several samples at intervals of two hours (Joint Sum. pp. 121-122). In all, experts employed by Massachusetts analyzed over 4000 samples taken from the Connecticut River (Joint Sum. p. 123). It is true that the Massachusetts experts employed monthly averages in their testimony. Dr. Rudolfs confined his attention to particular days in which conditions were at their worst [and during all of which, if the Massachusetts project as modified by the War Department findings had been in effect, there would have been a release of additional water from the Swift River Reservoir]. The objective of the experts called by Massachusetts was to get data of such reliability that it could be

employed in prognosis, and to do so it was necessary to average a quantity of analytical material. While the data have been applied in Exhibit D-14 to average stream conditions during the period of the investigation, they can be applied equally well to similar stream conditions during any other year or period of time. For instance, the situation disclosed for August, 1929, would be expected on any day or hour when the stream flow had the value that it had during August, temperature conditions being similar. Exceptional variations from the average during individual days in determining the effect of the Massachusetts diversion upon the state of the river as regards pollution are of slight importance, inasmuch as those individual days must necessarily have been influenced very materially by special conditions absolutely unconnected with the project. So far as the project would have affected them, it would have been by a tendency to decrease the intensity of pollution.

The comments made (*supra*, p. 34) with respect to page 142 of the Connecticut brief, so far as it purported to treat 1929 as an average year, are applicable to the statements found not only in the fourth whole paragraph on page 145, but also to the similar statements in the second whole paragraph on page 156.

Connecticut Brief, p. 146:

There is no question that large sludge beds exist during the dry seasons in the Connecticut River above the Massachusetts state line. The oxygen content of the water at the state line represents the oxygen left in the river after the effect of the sludge beds above that point in the river has been exerted (see Joint Sum. p. 130). To some extent the sludge beds are a benefit to the river from the Connecticut standpoint, as Mr. Robert Spurr Weston testified (Joint Sum. p. 129). Since "while all the sludge beds have an oxygen demand, they use up the oxygen more slowly when they are on the bottom of the stream than if

they are suspended in the water . . ." He also pointed out (Joint Sum. p. 129) that the formation of sludge beds retards the amount of demand upon the oxygen in the river which might be created lower down if the material in the sludge beds were to go down stream during the summer months. When the higher flow occurs, and some of the sludge beds are taken away by a freshet, they do no harm because at such a freshet time there is plenty of water to supply all the oxygen demand created by the beds. There was no evidence that the sludge beds gave off odors or otherwise caused any nuisance, nor was there any evidence as to the effect of the Massachusetts project, as modified by the War Department findings, upon formation of sludge beds. The effect of that diversion is the issue involved in this case.

Connecticut Brief, pp. 147 and 148:

In discussing the subject of "bathing" on "water supplies," Connecticut introduced no evidence to show that the effect of the Massachusetts project would be to alter the present state of affairs in the Connecticut River for the worse. Dr. Winslow, in particular, was most specific in saying that a diversion or addition of water resulting in a "change of 5 per cent either way was not of practical moment" (Joint Sum. p. 93). There was no evidence, as we have pointed out above, of a present intention on the part of Connecticut to use the Connecticut River for a water supply anywhere (see *supra*, p. 10).

Connecticut Brief, p. 150:

Population capacity is defined accurately in the evidence referred to at pages 52 to 53 of the original Massachusetts brief. *Population capacity* is a scientific term used to express the ability of the stream at any given point, not only to take care of the pollution which it then contains and to

carry it to the sea without the production of a nuisance, but also its reserve capacity to take care of additional pollution without creating a nuisance. *Population capacity* thus is expressed in terms of the number of persons whose sewage could be taken care of *in addition to* the sewage already in the river at a given point. In the first paragraph on page 152 counsel for Connecticut fall into error when they say that if the population capacity is reached "there is no oxygen left." On the contrary, if the population capacity of the river at the state line were at any time reached, there would be enough oxygen in the river at the state line to carry all the sewage then in the river safely to the sea, regardless of any later re-aeration. The fact that considerable re-aeration takes place between the state line and a point below Hartford means that so long as the population capacity at the state line is not exhausted [and there is no evidence of any time when it has nearly been exhausted] the Connecticut River in Connecticut will not be a nuisance. In the third whole paragraph on page 152 it is stated that the present population *equivalent load* on the Connecticut River at the state line is 619,000 people. Of course the figure of 619,000 *equivalent load* above the state line has already been included in the analytical determinations upon which the *population capacity* (which is a *net* figure above the present population *equivalent load*) of the river at the state line is computed. This figure of population *equivalent load* also includes all the pollution contributed by Vermont and New Hampshire, which Dr. Rudolfs said was so far upstream that by the time it reaches the Massachusetts-Connecticut state line it has all been oxydized (Joint Sum. p. 106). In the second whole paragraph of the Connecticut brief, on page 152, some figures from Exhibit D-14 are printed. For the convenience of the court Exhibits D-14 and D-15 are here printed in full.

Exhibit D-14.

Summary of Computations from Analytical Data Showing Population Capacity of Connecticut River at State Line, and Estimated Effect of Swift and Ware River Diversions and Releases, as Authorized by the Massachusetts Legislation and as Modified and Restricted by the War Department Regulations.

POPULATION CAPACITY.

Month	(1) Capacity at State Line	(2) Capacity by Release or Diversion, Swift and Ware Rivers	(3) Net Capacity at State Line	(4) % Change	(5) % Change in Flow
1928					
Oct.	3,987,000	—59,000	3,928,000	—1.5	—1.3
Nov.	7,004,000	—85,000	6,919,000	—1.2	—1.2
Dec.	8,603,000	—135,000	8,468,000	—1.6	—1.6
1929					
Jan.	14,542,000	—327,000	14,215,000	—2.2	—2.2
Feb.	7,872,000	—194,000	7,678,000	—2.5	—2.7
Mar.	86,950,000	—2,175,000	84,775,000	—2.5	—2.8
April	144,760,000	—2,410,000	142,350,000	—1.7	—2.1
May	56,385,000	—1,018,000	55,367,000	—1.8	—2.0
June	2,368,000	—38,000	2,330,000	—1.6	—1.5
July	649,000	—6,000	643,000	—0.92	—0.62
Aug.	368,000	+5,000	373,000	+1.4	+0.90
Sept.	416,000	+4,000	420,000	+0.96	+0.75
Oct.	1,002,000	+8,000	1,010,000	+0.80	+0.57
Nov.	3,488,000	—14,000	3,474,000	—0.40	—0.30
Total	338,394,000	—6,444,000	331,950,000		
Average	24,171,000	—460,000	23,711,000	—1.9	—1.9

Note: Column (2) plus = release, minus = diversion.

Exhibit D-15.

Showing Relative Population Capacities of the Connecticut River at the State Line and Rocky Hill, Connecticut, under conditions prevailing from October, 1928, to November, 1929, inclusive.

POPULATION CAPACITY.

Year and Month	At Sta. 1 State Line	At Sta. 20 Rocky Hill
1928		
October	3,987,000	5,621,000
November	7,004,000	10,608,000
December	8,603,000	12,250,000
1929		
January	14,542,000	23,250,000
February	7,872,000	14,559,000
March	86,950,000	238,720,000
April	144,760,000	442,380,000
May	56,385,000	121,210,000
June	2,368,000	3,929,000
July	649,000	1,409,000
August	368,000	816,000
September	416,000	1,000,000
October	1,002,000	2,476,000
November	3,488,000	6,223,000

Average increase for 14 months = 157%

It will be observed that at every critical period included in the period covered by the exhibit (August, 1928, to November, 1929) the Massachusetts project as modified by the War Department findings, had it been in effect, would have added to the *population capacity* of the Connecticut River at the Massachusetts-Connecticut state line. Exhibit D-15 shows that at all times the *population capacity* at Rocky Hill, below Hartford, after receiving the sewage of Hartford was greater than the *population capacity* at the state line. This is of course due to the rapid re-aeration between the state line and a point just above Hartford. An examination of Exhibit D-14 also shows

how grossly misleading are the statements in the paragraph beginning at the bottom of page 152 and in the first whole paragraph on page 153. It is of course true that in times of very high flood, such as in April, 1929, the Massachusetts diversion, amounting to a 1.7% change in *population capacity*, would affect the *population capacity* of the stream by as much as 2,410,000 persons. However, at the time that this change would have occurred the *population capacity* of the Connecticut River at the state line was 144,760,000 people, a population capacity in excess of the total population of the United States including Alaska and the Insular Possessions [Population of Continental United States (1930) 122,775,046; estimated population of Alaska and Insular Possessions (1928) 13,601,059]. The lowest figure of *population capacity* shown on Exhibit D-14, that of 368,000 in August, 1929, does not indicate any serious condition. The river at the state line at that time could have cared for the sewage of 368,000 more people, and could have carried it safely to the sea without any allowance whatsoever for re-aeration. However, re-aeration would have exerted such an effect that *population capacity* even after receiving the sewage of Hartford would have been 816,000 at Rocky Hill.

Connecticut Brief, pp. 154-155:

The possible effect of the proposed new dam at King's Island is of course unknown. The evidence was conflicting, and properly so. The additional storage would probably improve the bacteriological situation, and even Dr. Rudolfs testified that the re-aeration would not be reduced more than one half (Joint Sum. p. 115).

Connecticut Brief, p. 156:

The paragraph labelled "b. During high flow" contains the same mistake as to the effect of the War Department

findings commented on *supra*, pp. 4-8. There is absolutely no evidence that the diversion during periods of high floods will in any way remove or diminish the scouring effect which the floods have upon the river. As to the comments on sludge beds, see *supra*, p. 37. With respect to the last paragraph on page 156, it is submitted that Dr. Winslow's statement, already referred to, as to complete inability by analyses to detect changes caused by the removal of 5% of the oxygen in the Connecticut River (Joint Sum. p. 90), covers the whole case on pollution, inasmuch as no other means of detection or observation can approach the sensitivity or accuracy of chemical analyses. Computations on Exhibit D-14 as to diversion from and additions to the flow of the Connecticut River are computations purely as a matter of mathematics.

Connecticut Brief, p. 158:

The statement at the bottom of the page, that the Special Master found that there was no indication that the policy of Massachusetts in permitting its streams to remain polluted will change, is completely in error. If he had made such a finding it would have been in error (see argument Original Massachusetts Brief, p. 56).

Connecticut Brief, p. 159:

The table of estimates introduced by Dr. Rudolfs as to the probable state of the Connecticut River was based upon conditions during an unusually dry summer like 1929 (during which the samples upon which Connecticut experts based their conclusions were taken). This is apparent from Dr. Rudolfs' testimony (Joint Sum. p. 106). As to the water policy of Connecticut as to pollution, see Massachusetts brief, p. 56.

Connecticut Brief, p. 160:

General Wadhams did not testify that all the available clean water resources of the state of Connecticut are already developed. There was no evidence that they were (Joint Sum. p. 143, see *supra*, p. 10). It is significant that General Wadhams testified that some Connecticut streams are so polluted as to be absolutely hopeless so far as cleaning them up is concerned (Joint Sum. pp. 148-150).

Connecticut Brief, p. 162:

The argument of Massachusetts in support of the Special Master's findings that fish life will not be injured by the Massachusetts project will be found in the original Massachusetts brief, at pages 71 to 74.

Connecticut Brief, p. 166:

The criticism of Exhibit D-12 by Connecticut is unwarranted. Dr. Winsor presented an analysis of certain Connecticut exhibits purely for the purpose of showing that they did not prove what counsel for Connecticut claimed that they proved (see Joint Sum. p. 157). The technique employed by Dr. Winsor to investigate whether or not there was any correlation between May floods and the shad run conformed to that commonly employed by statisticians. Instead of confusing the issue it actually results in the elimination from the problem of all the other variable factors referred to by counsel, and shows in the simplest possible way the entire lack of correlation between the two variables under study, that is, the shad run and the height of floods.

It is of course true that the waters between the Massachusetts-Connecticut state line and the Enfield Dam are in no way related to the shad industry, for it was in evi-

dence that the shad do not go above this dam (Joint Sum. p. 153). From the undisputed testimony it appears that all analyses of waters showing low dissolved oxygen content were of waters north of the Enfield Dam. Even with respect to these waters there was no evidence that any of the daily observers or investigators found any dead fish whatsoever during continued warm weather. It would be natural to suppose that, if the river became so bad as to be unable to support fish life, the presence of large numbers of dead fish would come to the notice of competent river observers.

Connecticut Brief, p. 173:

The argument of Massachusetts in support of the Special Master's finding that the available pure water supplies in Eastern Massachusetts are inadequate for the Metropolitan District about Boston, and for Northeastern Massachusetts generally, will be found at pages 134 to 155 of the original Massachusetts brief.

The criteria given by Professor Winslow as to the elements to be taken into consideration in determining whether water is available for use as domestic supply were more technical, and less inclined to take account of human weaknesses, than those of other experts called by Connecticut. The Special Master (Rep. Sp. M. 47) called attention to Dr. Winslow's academic adherence to pure theory as opposed to the reasonable consideration of practical matters by the other experts who testified, all of whom had had more direct contact with the construction and administration of water supplies than Professor Winslow. The uniform preference of all the other experts on both sides for pure upland streams, rather than polluted waters, as the original source of a water supply, leads one to suspect that Professor Winslow has allowed his belief in the theoretical perfection of modern treatment methods to become

somewhat of an obsession [see Dr. Rudolfs' testimony, Joint Sum. p. 188, Dr. Gregory's (called by Connecticut), Joint Sum. p. 199, Mr. Jacobs', Joint Sum. p. 179; see also the opinion of experts called by Massachusetts: Mr. Goodnough, Joint Sum. p. 228 *et seq.*, Mr. Howard, Joint Sum. p. 234, Mr. Sullivan, Joint Sum. p. 236, Mr. Kennison, Joint Sum. pp. 252-254, Mr. Sanborn, Joint Sum. p. 258, Mr. Barbour, Joint Sum. p. 267, Mr. Weston Fuller, Joint Sum. p. 276, Mr. Eddy, Joint Sum. p. 288, Mr. George Fuller, Joint Sum. p. 291, Mr. J. Waldo Smith, Joint Sum. p. 299].

Connecticut Brief, p. 174:

The discussion of the legislative reports in the Connecticut brief, p. 174 *et seq.* should be compared with the discussion in the original Massachusetts brief, at page 34 *et seq.*

Connecticut Brief, p. 175:

The quotation at the bottom of page 175 of the Connecticut brief, from Exhibit C-3 (the 1895 Report), is misleading because it is only a partial quotation. Immediately following the statement quoted appears the following language in the report:

> "The estimated cost of filtering and conveying this water to the metropolitan district is $17,500,000; but in the opinion of the Board it will be better to pay 10 per cent. more for a supply from a source that has not been polluted. The experiments carried on by this Board for a succession of years at an experiment station in Lawrence under the immediate direction of H. F. Mills, C. E., a member of this Board, and the filter constructed in connection with the water works of that city, have shown that waters as polluted as those

of the Merrimack can be effectually filtered and rendered safe for domestic use; but it is also true that filtering areas require continuous care on the part of the well-trained attendants, and that, in a few instances at least, inefficient administration or inherent defects of construction have allowed disease germs to pass through filters which were assumed, by good authority, to be a sufficient protection."

See also the evidence of the Massachusetts experts quoted at length by the Special Master, and obviously relied upon by him (see Rep. Sp. M. 39-52).

Connecticut Brief, pp. 177-178:

The quotation from Exhibit C-1 at the bottom of page 177 is not, as one would assume from reading the Connecticut brief, from the report of the Commission itself, but it is a statement of an engineer employed by them. In the portion of the report (Exhibit C-1, p. 16) written by the Commission itself the following statement is made:

"The Assabet River was suggested in 1895 as the source from which the first additional supply should be taken, but the conditions have so changed meantime, due to the industrial development along the course of the stream, that it will not be wise to consider the use of this water as a possible regular source of supply. Yet inasmuch as the aqueduct from the Wachusett Reservoir passes through this watershed, the Assabet water could be readily diverted into it and used in case of a serious emergency. In fact, such an available emergency supply is an asset which should not be overlooked, as it will enable the district to follow safely a somewhat more conservative policy in regard to future extensions of the works than would otherwise be the case."

Similarly, the quotation from page 169 of the same report, found at the bottom of page 178 and the top of page 179, is incomplete in that it fails to include the following statement from Exhibit C-1, pages 169 to 170, which seriously modifies the effect of the passage quoted in the Connecticut brief:

> "The advisability, as a general policy, of limiting the amount of water that may be diverted from the rivers of the state so as to prevent serious diminution of their flow, especially at times when the flow is small, will hardly be questioned at the present time.
>
> "With conditions as they now are, if water is to be taken from streams in the Assabet watershed as proposed, the taking should be a limited one" (see Exhibit C-1, pp. 169-170).

This passage shows that only absolutely necessary attention was being given to the need of downstream communities for a minimum amount of water for dilution purposes.

Connecticut Brief, p. 180:

The passage quoted, at the top of page 180 of the Connecticut brief, from page 160 of Exhibit C-1, is followed by several pages in that exhibit of various objections to taking the waters of the Merrimack River. These objections are summarized by the engineer of the Commission as follows (Exhibit C-1, pp. 162-163):

> "But the most important of all, the taking of water from the Merrimack River would supply the Metropolitan Water District from a polluted source which is gradually and surely growing worse. The objections to this scheme in 1895 were summed up by the chief engineer of the Board at that time, as follows:—
>
> " 'Of these two plans, I have no hesitation in recommending the one for taking water from the Nashua

River, mainly because I believe that the small advantage which the Merrimack River plan has in regard to cost does not outweigh the disadvantage of taking a water which requires purification to make it suitable for drinking. Even if it were admitted that sand filtration with scientifically constructed filters and intelligent management will entirely remove disease germs from water, there is still the chance in the administration of a work of this kind that the preparation may be unscientific and the management unintelligent, which may cause the water to be either imperfectly purified by filtration, or, by accident, carelessness or the necessity of maintaining the supply, sent to the Metropolitan District without any filtration whatever. There is another objection to the Merrimack scheme which I regard as of importance,—that there is a greater danger that the supply may be interrupted through some accident at the pumping stations or filter beds, or by a temporary failure of the supply of coal or of skilled labor required to operate the works . . .'"

Regarding the use of the Merrimack River for a water supply by the cities and towns in the Merrimack River Valley (Exhibit C-1, p. 26), the Joint Board says:

"A report made for us by Mr. H. W. Clark has shown the feasibility of filtering the water of the Merrimack River above Lowell, but there are sufficient reasons against the use of this supply. At the present time this is known by the attitude of the citizens of Lawrence against their present supply taken from the Merrimack River above that city. Even though the water be rendered safe for use by the processes of filtration and chlorination, the citizens have repeatedly expressed repugnance against the use of a stream so

heavily polluted, when it is possible for another source of supply to be obtained."

The last sentence of the second quotation appearing on page 180 of the Connecticut brief, suggesting that an almost inexhaustible supply of water for the Metropolitan District would be furnished by the Merrimack River, is clearly contradicted by the strong evidence of Mr. Kennison (Joint Sum. p. 244), Mr. Barbour (Joint Sum. pp. 275-276), and Mr. Weston Fuller (Joint Sum. p. 273). The fact that there is no adequate storage for the Merrimack River, the fact that restrictions of the War Department may cut down the yield, and the essential requirements of downstream communities for a minimum amount of water in dry seasons to dilute inevitable pollution, all render the amount of yield to be obtained from the Merrimack River purely speculative. This subject is fully discussed in a brief filed by Massachusetts before the Special Master, copies of which are in the possession of the clerk of this Honorable Court. [The brief referred to is bound in green (see pages 110-120 thereof).]

Connecticut Brief, p. 181:

The argument of counsel for Connecticut to the effect that Massachusetts is reprehensible because water has been wasted in the past because the Wachusett Reservoir was not large enough to hold all that could have been obtained from the watershed tributary to it is strangely inconsistent with the argument of counsel for Connecticut that Massachusetts is now proposing to build too large a reservoir on the Swift River. One of these two arguments must fall. The contentions in the Connecticut brief, at pages 181 to 183, are in themselves abundant proof that the Swift River Reservoir should be made thoroughly adequate in size.

Connecticut Brief, pp. 185-186:

It is significant that Mr. Hazen, in the 1925 report (Exhibit C-2; discussed in the Original Massachusetts Brief, at page 38 *et seq.*), was forced to resort to a recommendation of the Ware River flood waters in order to obtain an adequate yield for the Metropolitan District of Boston. His recommendation included a very large taking from the Ipswich River, which, as we have shown above (*supra*, p. 12), would only be a make-shift because of the future needs of Essex County communities. The suggestion at the top of page 180 of Connecticut's brief, that Mr. Hazen's recommendation of a compensating reservoir on the Ware River was for the purpose of maintaining the flow of the Connecticut River, is absurd. The diversion of a few of the upland waters of the Ware River would certainly have had no appreciable effect upon the Connecticut River. The purpose of the compensating reservoir was to benefit the mills on the Ware and Chicopee Rivers. The attention of the Court is called to the fact that the Massachusetts Legislature rejected the recommendations of this report.

Connecticut Brief, p. 189:

As we have shown above (*supra*, pp. 11-12), the scheme for obtaining a supply from the Merrimack, in conjunction with the Ipswich, testified to by Mr. Kennison (Joint Sum. p. 244), was introduced by him purely for the purpose of meeting so far as possible obvious and serious objections to the scheme which the Connecticut experts had been advocating and for the purpose of showing that, even were these objections met, the best possible scheme for making use of the waters of the Merrimack River would be an exceedingly bad and dangerous water supply scheme (Joint Sum. p. 243 *et seq.*). Mr. Kennison perfectly obviously regarded this scheme as a last resort for Metropolitan Bos-

ton, and one to be utilized only under the most rigorous compulsion.

Connecticut Brief, p. 190:

The suggestion in the Connecticut brief, in the last paragraph on page 190, that the Knowles' report is out of date, is hardly true. It was brought up to date by Mr. Dooley's testimony (see Original Massachusetts Brief, p. 145; see Joint Sum. pp. 232-233).

Connecticut Brief, p. 193:

The Lawrence supply, which is now taken from the Merrimack River, is treated by slow sand filtration. That method, which is exceedingly expensive, is apparently the most satisfactory way of treating waters very heavily polluted with industrial wastes. Mr. McCarthy's evidence (see Joint Sum. p. 239) shows that a modern mechanical (or rapid sand) filter on occasions would not work with Merrimack River water. Despite the fact that the experimental station had every device known to water purification science at its disposal, there were long periods when it was found impossible to filter Merrimack River water because they were unable to obtain satisfactory coagulation, an essential step in mechanical filtration. Mechanical filtration was the method suggested by Connecticut experts for the proposed purification of the waters of the Merrimack River (see Joint Sum. p. 166).

Connecticut Brief, p. 196:

The testimony of Mr. Howard as to the policy in New Hampshire makes it clear that there is no reasonable probability that New Hampshire will adopt a different policy of protection and conservation of its streams in the near future (Joint Sum. p. 234; compare Connecticut brief, pp. 161-162).

Connecticut Brief, p. 197:

The intercepting sewers, referred to in the middle of page 197 of the Connecticut brief, would of course have no effect on improving the state of the Merrimack River, as regards pollution at Tyng's Island, above Lowell, the point at which it was suggested by Connecticut that Boston should obtain water from the Merrimack River. The quoted statement of the Special Master (from page 45 of his report) is directed to a consideration of the pollution content of the water at Tyng's Island and had nothing to do with the water at any point nearer the sea than Tyng's Island.

Connecticut Brief, p. 198:

With reference to Mr. Eddy's testimony, see the arguments contained in the original Massachusetts brief, at page 147.

Connecticut Brief, p. 199:

The evidence shows that the water power at Lawrence and Lowell is significant "in comparison with the capacity of" steam power plants at those points (see Joint Sum. p. 182). The installed steam power at Lawrence is approximately 75,000 horsepower, as compared with 25,000 horsepower of installed water power. At Lowell the steam power is only 25,000 horsepower, as compared with installed water power of nearly 30,000 horsepower.

Connecticut Brief, p. 203:

The statement at page 203 of the Connecticut brief, that a sanitary survey of the Merrimack River reveals nothing in New Hampshire in the drainage area as far north as Concord, New Hampshire, that would be objectionable or impossible to treat, is erroneous. Beside the general testi-

mony of Mr. Barbour quoted in the report of the Special Master, pages 40 to 43, must be considered the testimony of Mr. George Fuller (Joint Sum. p. 294) as to the dangerous phenol and gas wastes at Manchester, and as to the wood pulp mill at Lincoln. In addition to Mr. Eddy's striking testimony (summarized Massachusetts Brief, p. 146, Joint Sum. p. 278 *et seq.*) as to the industrial waste content of the water at Tyng's Island, there is the specific testimony of Mr. Howard, Chief of the Division of Chemistry and Sanitation of the New Hampshire Board of Health (found in the original transcript, though not set out in full in the Joint Summary), as to the existence of gas works and other manufacturing plants at Concord, Nashua, and Manchester (see Transcript, pp. 1687, 1688, 1689). The difficulty of treating pulp and phenol wastes is described by one of Connecticut's own witnesses, Major Whitman (Joint Sum. pp. 191-193), by Mr. George Fuller (Joint Sum. p. 294), and by Mr. Barbour (Joint Sum. pp. 262-264). Although Lincoln is north of Concord, New Hampshire, the influence of the wastes from the pulp mill in that town would make the filtration of Merrimack River water at Tyng's Island very difficult.

Connecticut Brief, p. 209:

It would seem that, instead of the modern trend of water treatment being toward the adoption of the filtration of polluted waters, the modern trend was toward obtaining pure upland water sources wherever that was possible. The situation in Albany was described by Mr. Whitman, an engineer called by Connecticut (Joint Sum. p. 193). We have mentioned (*supra*, p. 45) the preference of all the experts except Professor Winslow for upland supplies wherever those are available [see especially the testimony of Mr. Barbour at page 263 of the Joint Summary of Evidence].

Connecticut Brief, pp. 216-217, 221:

As to the subject of the burden of proof, see the discussion in the original Massachusetts brief, at page 151 *et seq.*

Connecticut Brief, p. 240:

In considering the reference, in the last paragraph of this page of the Connecticut brief, as to the scheme put forward by Mr. Kennison, see the argument, *supra*, p. 11.

Respectfully submitted,

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R. AMMI CUTTER.

Office Supreme Court, U. S.
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Supreme Court of the United States

No. 12 Original, October Term, 1929.

STATE OF CONNECTICUT,

Complainant,

vs.

COMMONWEALTH OF MASSACHUSETTS,

Defendant.

REPORT OF CHARLES W. BUNN, SPECIAL MASTER.

Supreme Court of the United States

No. 13 Original, October Term, 1929.

STATE OF CONNECTICUT,

Complainant,

vs.

COMMONWEALTH OF MASSACHUSETTS,

Defendant.

REPORT OF CHARLES W. BUNN, SPECIAL MASTER.

December 2, 1929, the Court appointed the undersigned as Special Master with power to summon witnesses, issue subpoenas, and to take such testimony as might be introduced and such as he might deem necessary to call. The Master was directed in the order to make findings of fact and conclusions of law and to submit the same to the Court with all convenient speed, together with his recommendations for a decree.

Accordingly the Master between February 18 and March 21, 1930, at Boston and at Hartford took such testimony as the parties introduced and found no occasion to call other witnesses.

In accordance with said order the Master herewith presents his findings of fact and conclusions of law with recommendations for a decree.

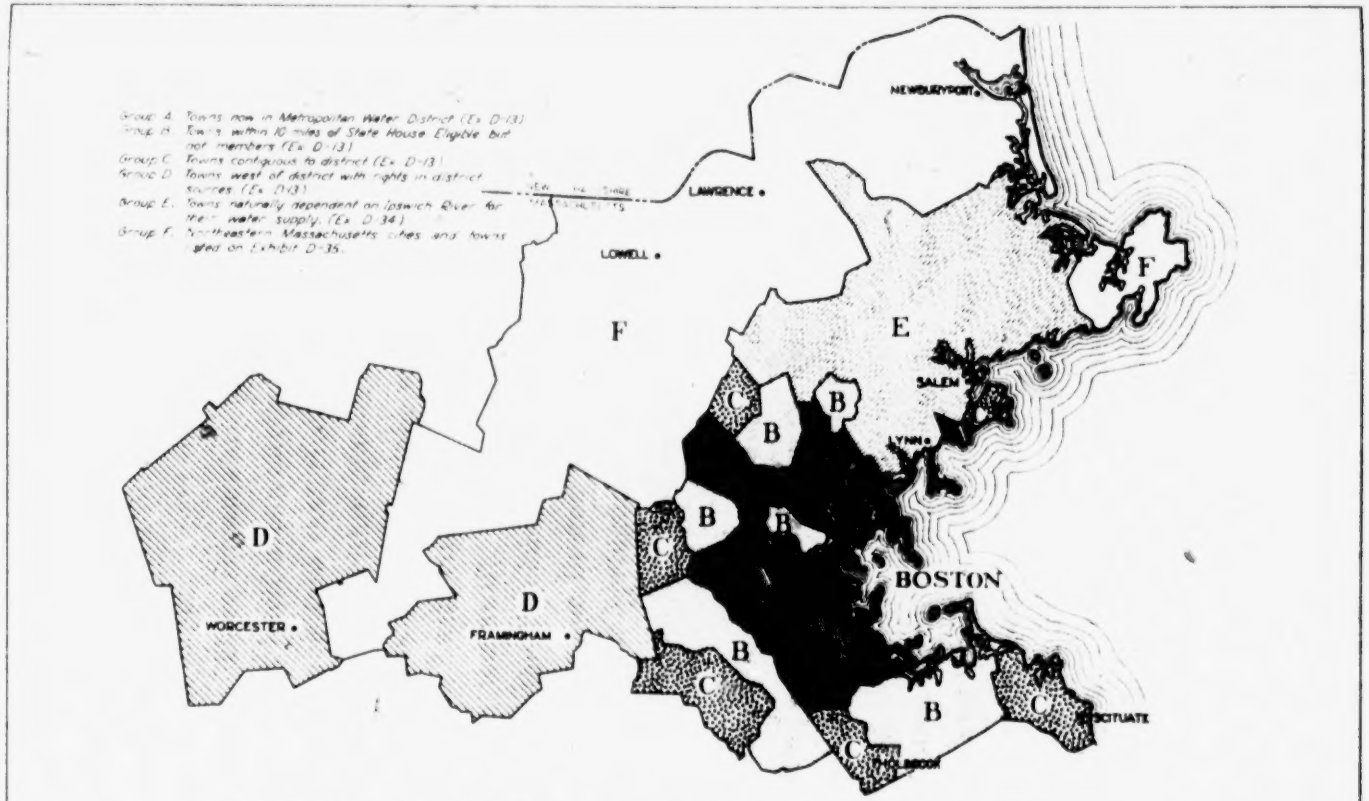
GENERAL FACTS.

The bill was filed by the State of Connecticut seeking to enjoin the Commonwealth of Massachusetts from diverting for Boston water supply a part of the waters of the Ware and Swift rivers. These streams are unnavigable tributaries of the Chicopee river, itself a non-navigable tributary of the Connecticut discharging into that river just above Springfield, and are situated wholly within Massachusetts.

The project is to take certain waters from the Ware river and from the Swift river and to establish eventually a large reservoir on the Swift. These waters are to be led through a conduit into the Wachusett reservoir, the present main source of water supply for Boston and neighboring towns and cities. A few miles below Springfield the Connecticut river enters Connecticut and flows in a southerly direction to Rhode Island sound. Long

The Connecticut rises in Canada and northern New Hampshire, flows southward between New Hampshire and Vermont and through Massachusetts. It is the largest river in New England, being about 345 miles long and draining an area of 11,300 square miles, of which 1,385 are within Connecticut.

Boston and the surrounding metropolitan area are faced with a serious water shortage in the near future and there is a real necessity for their making provision for a large quantity of additional water which will meet the needs of the region for a considerable number of years. The metropolitan area consists of 20 cities and towns, and 15 other cities and towns are eligible to become members; these 35 cities and towns have a population of about 1,900,000. Other cities and towns must be considered in intimate connection with the Metropolitan District, because first they are likely to depend on District water supplies at some future time, and secondly as will later



COMMONWEALTH OF MASSACHUSETTS ~ METR. DISTR. WATER SUPPLY COMMISSION

MAP SHOWING GROUPS OF NORTHEASTERN MASSACHUSETTS CITIES AND TOWNS REFERRED TO IN EXHIBITS D-13, D-33, D-34 AND D-35.

(BASED UPON MATERIAL FOUND ON EXHIBIT D-13aa)

APRIL 7, 1930

appear, if Ware and Swift waters be denied to Boston, all populations in the northeastern part of the state must divide up water supplies on a fair principle of equality of right. In this view the needs of the population of northeastern Massachusetts taken as a whole must be considered; insert opposite this page shows the territory. The total population thus concerned is now 2,860,000, estimated likely to reach a total in 40 years of 4,572,000. This whole region has a total present water supply of 343,000,000 gallons per day and a total consumption of 244,000,000 gallons per day, leaving a surplus of 99,000,000 per day. But use of water is increasing and population is increasing. Dry seasons have occurred when the Metropolitan District has been imminently close to water shortage. In 1970 owing to disuse of some of them the present supplies will probably have decreased from 343,000,000 to 289,000,000 gallons per day and the consumption requirements will probably have increased from 244,000,000 to 467,000,000 gallons per day, leaving a deficit of 178,000,000 gallons per day.

There is no serious dispute about the need of this region to provide presently for additional water.

Speaking in a general way this is the situation which led the Massachusetts legislature to provide for securing a water supply from the Ware and Swift rivers. It passed the act of 1926, c. 375, and that of 1927, c. 321, which are printed in defendant's reprint of answer p. 36-80. The plan of these laws was diversion into Wachusett reservoir (the principal present supply of Boston), of (a) flood waters of the Ware river (act of '26), and (b) certain waters of the Swift river (act of '27).

Because of possible effect of the proposed Ware and Swift works upon navigation of the Connecticut, Massachusetts applied to the Secretary of War under the act of Congress of March 3, 1899, ch. 425, sec. 10, for authority to divert Ware and

Swift waters as proposed. The Secretary of War after hearing both sides and examining the facts made a finding that the proposed diversion of the Ware river "will have no adverse effect on the navigable capacity of the Connecticut River" (reprint of answer p. 81-87). He also found that no impairment of the navigable capacity of the Connecticut would result from the diversion which his order permitted from the Swift river. The Secretary determined that no objection would be interposed by the War Department to these diversions. He permitted diversion of flood waters of the Ware in excess of 85,000,000 gallons per day between October 15 and June 15 and prohibited the taking of any water whatsoever except during that period. He permitted diversion of all waters of the Swift except enough to maintain a flow of 20,000,000 per day, but required during the period June 1 to November 30, both inclusive, release of 110 cubic feet per second (71,000,000 gallons a day) from the impounding dam on the Swift river whenever the flow of the Connecticut at Sunderland, Massachusetts (a town about 20 miles north of the confluence of the Chicopee and Connecticut), is 4650 cubic feet per second or less; and when the flow of the Connecticut river is more than 4650 and less than 4900 cubic feet per second 70 cubic feet per second (45,000,000 gallons a day) he required to be released. The Secretary found that discharge of 4900 cubic feet per second at Sunderland corresponds to an average gauge height at Hartford of 2.1 feet and a discharge of 4650 cubic feet per second at Sunderland means 2 feet gauge height at Hartford.

The annual flow of Connecticut river at the Massachusetts-Connecticut boundary is about 17,000 cubic feet per second (approximately 11,000 millions gallons a day); total watershed of Connecticut river 11,300 sq. miles, and watershed lying above Massachusetts-Connecticut boundary 9,915 sq. miles;

drainage area of Connecticut river watershed in Connecticut 1,385 sq. miles; drainage of Ware river at point of diversion 98 sq. miles; drainage of Swift river at point of diversion 186 sq. miles.

Diversions of the Ware and Swift as permitted by the Secretary of War will furnish about 191,000,000 gallons of water per day. The Massachusetts acts do not authorize diversion of any waters other than the Ware and Swift, and as to these the record shows that (as far as counsel can commit it) Massachusetts proposes to abide by the Secretary of War's requirements and restrictions touching the diversion.

The total drainage area of both the Ware and Swift subject to diversion is 2.93 per cent of the total watershed of Connecticut river above Connecticut. Diversion of water to the extent authorized by the Secretary of War represents an average yearly subtraction from the flow of the Connecticut at the state line of about 2 per cent; but 94 per cent of this diversion occurs when the Hartford gauge reads above $3\frac{1}{2}$ feet, which means $13\frac{1}{2}$ feet depth of water. Two feet on the Hartford gauge indicates 10 feet of water, which is the depth the government heretofore has sought to maintain below Hartford. But a War Department project contemplates a future 12-foot channel and nearly all the diversion proposed will be when there is more than that depth of water.

Many maps were introduced in evidence. Attached hereto will be found a map of convenient size sufficient for a clear understanding of most features of the case.

The complaint of Connecticut for an injunction against the proposed diversion is grounded on the allegation that any subtraction from the flow of the Connecticut through that state is a serious damage to the state and its people in that (a) it injures the navigability of the stream, (b) certain lands in the

Connecticut river bottom subject to yearly inundation will be injured by diminution of such inundation, (c) probability of a power development at King's Island, a few miles below the Massachusetts-Connecticut line, and the proposed diversion would diminish this power, (d) the run of shad is favored by high spring floods and the proposed diminution of these will seriously diminish this run, (e) the Connecticut river is a carrier of sewage from population and waste from factories, and diminution of the flow will decrease the capacity of the river to discharge and destroy this pollution. Much testimony was taken upon each of the foregoing topics.

In addition Connecticut alleges by an amendment to its bill that the Boston district can well be supplied with good water from the eastern part of Massachusetts and for this reason should be enjoined from subtracting in the least from flow of water into the Connecticut. A large amount of testimony was taken upon this subject.

PRELIMINARY QUESTIONS OF LAW.

Before taking up the specific grounds for relief above stated it will be convenient to consider a general contention which Connecticut pressed earnestly upon the argument. That contention is first that any invasion of the rights or privileges of a sovereign state calls for injunction regardless of damage, and even though not the slightest actual damage results; second that the Supreme Court in a suit between two states will apply the law of the states rather than any rule of its own; and that consequently, where both states have adopted the common law of riparian rights, the Supreme Court of the United States has nothing to do but to apply the strict rule of the common law in determining such a controversy as this.

Regarding the first branch of the contention it ignores that injunction is not granted where there is an adequate remedy at law; and also it seems to me directly in the teeth of the cases of *Missouri v. Illinois*, 200 U. S. 496, 521; *New York v. New Jersey*, 256 U. S. 296, 309; and *North Dakota v. Minnesota*, 263 U. S. 365, 374. In the latter case the court said:

> "In such action by one state against another, the burden on the complainant state of sustaining the allegations of its complaint is much greater than that imposed upon a complainant in an ordinary suit between private parties. 'Before this court can be moved to exercise its extraordinary power under the Constitution to control the conduct of one state at the suit of another, the threatened invasion of rights must be of serious magnitude and it must be established by clear and convincing evidence.' *New York v. New Jersey*, 256 U. S. 296, 309; *Missouri v. Illinois*, 200 U. S. 496, 521."

I think equally unsound is the contention that the Supreme Court in a suit between two states which recognize the common law is confined to rules sanctioned by common law. The case of *Kansas v. Colorado*, 206 U. S. 46, at p. 97, shows that the court in deciding suits between states follows primarily international law. The court there quoting Mr. Justice Gray declared that international law is a part of our law and must be administered when rights depending upon it are presented for determination. Chief Justice Fuller's language in 185 U. S. 146, is also quoted with approval:

> "Sitting, as it were, as an international, as well as a domestic tribunal, we apply federal law, state law, and international law, as the exigencies of the particular case may demand."

In *Kansas v. Colorado* one state had adopted the common law, and the other state applied the principle of priority of

appropriation in determining water rights. The cardinal rule between states claiming rights in interstate rivers is shown both by *Kansas v. Colorado* (p. 94-96) and *Wyoming v. Colorado*, 259 U. S. 419, 464-5, to be equality of right; that the effect on both states of what is done in one state must be considered so that both states may secure as far as possible equality of right in use of the water.

In the former case the court said p. 100:

> "Suppose the controversy was between two individuals, upper and lower riparian owners on a little stream with rocky bank and rocky bottom. The question properly might be limited to the single one of the diminution of the flow by the upper riparian proprietor. The lower riparian proprietor might insist that he was entitled to the full, undiminished and unpolluted flow of the water of the stream as it had been wont to run. It would not be a defense on the part of the upper riparian proprietor that by the use to which he had appropriated the water he had benefited the lower proprietor, or that the latter had received in any other respects an equivalent. The question would be one of legal right, narrowed to place, amount of flow and freedom from pollution."

The court held that quite a different rule applied to suits between states within its original jurisdiction; that the cardinal rule as between states is equality of right, saying that the question should be viewed not narrowly and solely as to the amount of flow in the Arkansas river, inquiring merely whether any portion thereof was appropriated by Colorado, but rather to determine how much Colorado might fairly appropriate under the rule of equality and the effect of such appropriation upon the lower state. The court awarded to the upper state the use of a very large share of the water. In reaching this conclusion the court adopted its own rule of international

law. In each international case as it arises I think the Supreme Court will adopt that rule of law which best works out equality and equity in the particular case. The result reached in *Kansas v. Colorado* it seems to me would not have been different whether Kansas recognized to a certain extent appropriation rights in water or not.

A similar comment seems to me sound on *Wyoming v. Colorado*. Whilst it is true that in that case the court took pains to show that each state recognized prior appropriation of water, I think essentially it enforced that rule because it is the only just rule applicable to an arid country where irrigation is the first essential. The inquiry into state law was pertinent because the Supreme Court does not impose upon a state any particular system of law.

The *Chicago Drainage case* seems to me an authority upon this point. The court there in the final decree allowed a diversion estimated to reduce the level of the Great Lakes about one inch, and this diversion was into another watershed and to a sea several thousand miles from the mouth of the St. Lawrence. Illinois and I apprehend Canada and most of the states tributary to the Great Lakes follow the common law, and I understand that common law doctrine was urged in that case as prohibiting diversion to another watershed.

It was put to counsel for Connecticut on the argument whether the quantity of water sought to be diverted might be taken out and used for domestic purposes in Massachusetts if the population using it were in the Ware and Swift watershed. Counsel said such use would be lawful because it would be riparian and contended that by the common law water could not be diverted for domestic use outside the watershed. The contention on behalf of Connecticut was distinct that not one drop of water could be taken from the Ware or Swift for use beyond the watershed.

In the first place it seems to be doubtful if there is any such absolute and rigid rule of the common law. I think cases may be put where that would not be the rule, for example where the diversion causes no damage as where there is enough water for all. But whether there be such a universal principle or not, certain it is that Massachusetts has a right to change her common law, and by the legislation in question, so far as her power extends, she legalized the proposed diversion. I think it cannot be maintained that Connecticut has any vested right to insist that Massachusetts must continue common law rules as originally introduced from England.

This was the ruling in the case of *United States v. Rio Grande Irrigation Co.*, 174 U. S. 690, p. 702, where the court said:

> "While this is undoubted, and the rule obtains in those States in the Union which have simply adopted the common law, it is also true that as to every stream within its dominion a State may change this common law rule and permit the appropriation of the flowing waters for such purposes as it deems wise. Whether this power to change the common law rule and permit any specific and separate appropriation of the waters of a stream belongs also to the legislature of a Territory, we do not deem it necessary for the purposes of this case to inquire. We concede *arguendo* that it does.
>
> Although this power of changing the common law rule as to streams within its dominion undoubtedly belongs to each State, yet two limitations must be recognized: First, that in the absence of specific authority from Congress a State cannot by its legislation destroy the right of the United States, as the owner of lands bordering on a stream, to the continued flow of its waters; so far at least as may be necessary for the beneficial uses of the government property. Second, that it is limited by the superior power of the General Government to secure the uninterrupted navigability of all navigable streams within the limits of the United States."

The case of *Kansas v. Colorado*, pp. 94-96, sustains the same rule that each state may decide for itself what law of riparian rights it will apply, and that federal authority will not enforce any particular rule upon any state; that while it is undoubtedly true that early settlers brought to this country the common law of England, it is for the states to pass their own laws and Congress does not impose upon the states any particular rule.

In *Wyoming v. Colorado*, 259 U. S. 419, one of the grounds urged by Wyoming was that Colorado could not rightfully take the water into another watershed. The court, following the controlling principle that the river throughout its course was to be looked at as a single stream wherein each state had an equal interest, rejected the contention that Colorado could not divert water into another watershed, but said the fact of diversion into another watershed had a bearing in another connection, which I take to mean in determining whether the diversion proposed is reasonable and consistent with equality of right.

In that case to secure equality of right the court permitted Colorado to divert for irrigation in another watershed. I see no reason why the same principle should not apply here, provided only the diversion of water is reasonable and no more than consistent with Connecticut's equality of right. If Massachusetts would have a right to abstract this much water under any system of law she might follow and for any use legal by that system, I cannot see that Connecticut has a better right merely because she and Massachusetts adopted the common law of England.

For the foregoing reasons I feel constrained to rule against any right of Connecticut to object to the diversion regardless

of damage to the Connecticut river. I think the principle to be applied is equality of right, and the particular inquiry is whether the proposed diversion will seriously and substantially cripple the flow of, or otherwise injure, the Connecticut river. If abstraction of the proposed quantity of water will not work a serious injury to Connecticut it seems to me immaterial whether that water be taken for use beyond the watershed or not. The mere question of right to take it beyond the watershed is one for Massachusetts, subject to the right of Connecticut to say that nothing can be done to Connecticut river waters within Massachusetts which will largely injure that river in Connecticut.

In other words I think the case upon this branch resolves itself into a question of fact as to the effect of the proposed diversion, and that this question of fact must be passed on with due regard to the established rule that the proof must show clearly and convincingly a very substantial damage in order to call for injunction.

I.

I now take up the particulars in which Connecticut claims substantial damage to the flow or quality of the Connecticut river.

NAVIGATION—AS TO THE LAW.

It is shown by the testimony offered by Connecticut and is found that a substantial commerce is carried on between Hartford and New York (and neighboring ports), both passenger business and freight business largely coal and oil. Regular lines of boats ply in this commerce between Hartford and New York and its neighborhood. The Connecticut river has long been treated by the United States as navigable from Hartford

to the sea. An annual expenditure for years has been made by the United States in preserving and bettering this navigation. The aim of the United States has been to maintain a minimum 10-foot channel. The difficulties to be overcome consist of a number of bars which form annually in the river between Hartford and the Sound. Annually these bars have been dredged by the United States, this work being designed to maintain substantially a minimum 10-foot channel.

From Hartford up river as far as Holyoke small boats ply and carry a small business. There is a possibility of a large dam for power at a point a few miles south of the Connecticut line near the Windsor locks, and this dam, if built, would improve navigability between Hartford and Holyoke.

The Secretary of War as before stated made orders modifying and reducing the diversion of Ware and Swift water which would have been possible under the Massachusetts legislation. He finds that the diversion specified by him would not injure appreciably Connecticut navigation. But in view of this controversy then pending the Secretary said he issued no affirmative formal permit, simply determining that the United States would interpose no objection to the diversion. He required a discharge from the Swift river reservoir during the critical period of low water, which would increase instead of diminish the flow of water in the Connecticut, and to that extent better navigation.

In other words the Secretary consented on behalf of the United States to both the Ware and Swift diversion specified by him, but his order instead of being an affirmative license was of a negative character to the effect that the United States did not object. It seems to me his finding that the permitted diversion would not injure appreciably Connecticut navigation is conclusive if the action is within his authority. If Congress it-

self should fix the stage of water in the Connecticut adequate for navigation it would be conclusive and no state would be heard to contend in favor of a deeper, or shallower, or a different channel. *Pennsylvania v. Wheeling Bridge Co.*, 18 How. 421, 430; *South Carolina v. Georgia*, 93 U. S. 4, 11-12; *Miller v. Mayor*, 109 U. S. 385, 393-395; *Monogahela Bridge Co. v. United States*, 216 U. S. 177, 195; *Philadelphia Co. v. Stimson*, 223 U. S. 605, 635; *United States v. Chandler-Dunbar Co.*, 229 U. S. 53, 63-65; *Southern Pacific Co. v. Olympian Dredging Co.*, 260 U. S. 205, 208-210.

In *Monogahela Bridge Co. v. United States*, 216 U. S. at p. 195 the court said:

> "It was not for the jury to weigh the evidence and determine according to *their* judgment, as to what the necessities of navigation required, or whether the bridge was an unreasonable obstruction. The jury might have differed from the Secretary. That was immaterial; for Congress intended by its legislation to give the same force and effect to the decision of the Secretary of War that would have been accorded to direct action by it on the subject. It is for Congress, under the Constitution, to regulate the right of navigation by all appropriate means, to declare what is necessary to be done in order to free navigation from obstruction, and to prescribe the way in which the question of obstruction shall be determined. Its action in the premises cannot be revised or ignored by the courts or by juries, except that when it provides for an investigation of the facts, upon notice and after hearing, before final action is taken, the courts can see to it that executive officers conform their action to the mode prescribed by Congress."

In *United States v. Chandler-Dunbar Co.*, on p. 64 the court said:

> "So unfettered is this control of Congress over the navigable streams of the country that its judgment as to

whether a construction in or over such a river is or is not an obstacle and a hindrance to navigation, is conclusive. Such judgment and determination is the exercise of legislative power in respect of a subject wholly within its control."

The field of regulating navigation was left open to the states for many years by failure of Congress to act. See *Willson v. Black Bird Creek Marsh Co.*, 2 Pet. 245; *Escanaba v. Chicago*, 107 U. S. p. 678. But by the act of 1899 Congress seems very completely to have taken jurisdiction of everything pertaining to navigation. The rule is too well settled to admit of argument that whenever Congress enters a field originally common to federal and state law it thereby excludes state action within that field. *Sherlock v. Alling*, 93 U. S. 99; *Chicago, R. I. & P. R. Co. v. Hardwick Farmers Elevator Co.*, 226 U. S. 426; *Missouri P. R. Co. v. Stroud*, 267 U. S. 404.

It was suggested on behalf of Connecticut that the Secretary could not lawfully consent to diversion of water for domestic use, any more than he could for carrying off Chicago sewage, see *Wisconsin v. Illinois*, 278 U. S. 367, p. 400, and *Sanitary District v. United States*, 266 U. S. 405, pp. 429-430. The secretaries who granted the permits for diversion at Chicago never found that the diversion would not affect navigation. On the contrary it seems plain that both Secretaries recognized that the diversion would damage navigation (266 U. S. p. 430). The permits in that case were made temporary in view of the pending litigation and left undetermined to be decided in the litigation the effect of the diversion upon the height of water in the lakes. The court and master found that navigation was seriously injured by the diversion. What the court then held was that the Secretary had no right under Sec. 10 act of 1899 to divert water needed for navigation, merely to carry off

Chicago's sewage. Here on the contrary the Secretary after hearing of both sides has found that the diversion will not injure navigation; indeed he requires a discharge which will improve navigation at stages of lowest water; and concludes that the United States will interpose no objection.

The case of *Wisconsin v. Illinois* (see *Maine Water Co. v. Knickerbocker Steam Towage Co.*, 99 Me. 473, therein approved) determines that the phrase "affirmatively authorized by Congress", in Sec. 10, means authorized through the authority in that section delegated to the Secretary of War. And this was the practical interpretation of the statute by other governmental departments referred to by Chief Justice Taft.

I think it cannot be maintained that every structure in order to come within Sec. 10 must be one purely for the purpose of aiding navigation. The language of the section negatives this. It authorizes the Secretary to consent to any "obstruction" described. It mentions any wharf, pier, dolphin, boom, weir, breakwater, bulkhead, jetty, or other structure, etc., outside established harbor lines or where no harbor lines have been established, and it includes as it seems to me dams and other obstructions and diversions in tributaries of navigable waters which may affect navigability. It seems to me the Secretary under Sec. 10 may authorize a dam on a tributary upon finding that it would not injure navigation. He might license such dams for power, boating, propagating fish, etc., etc. The act prohibits *unreasonable* obstruction to navigation (278 U. S. 413) and the Secretary is authorized to determine for Congress what obstructions are unreasonable. Works on unnavigable tributaries of navigable waters are subject to the paramount rights of the United States over navigation, and the Secretary has jurisdiction over such structures. *United States v. Rio Grande Irrigation Co.*, 174 U. S. 690, pp. 707-709.

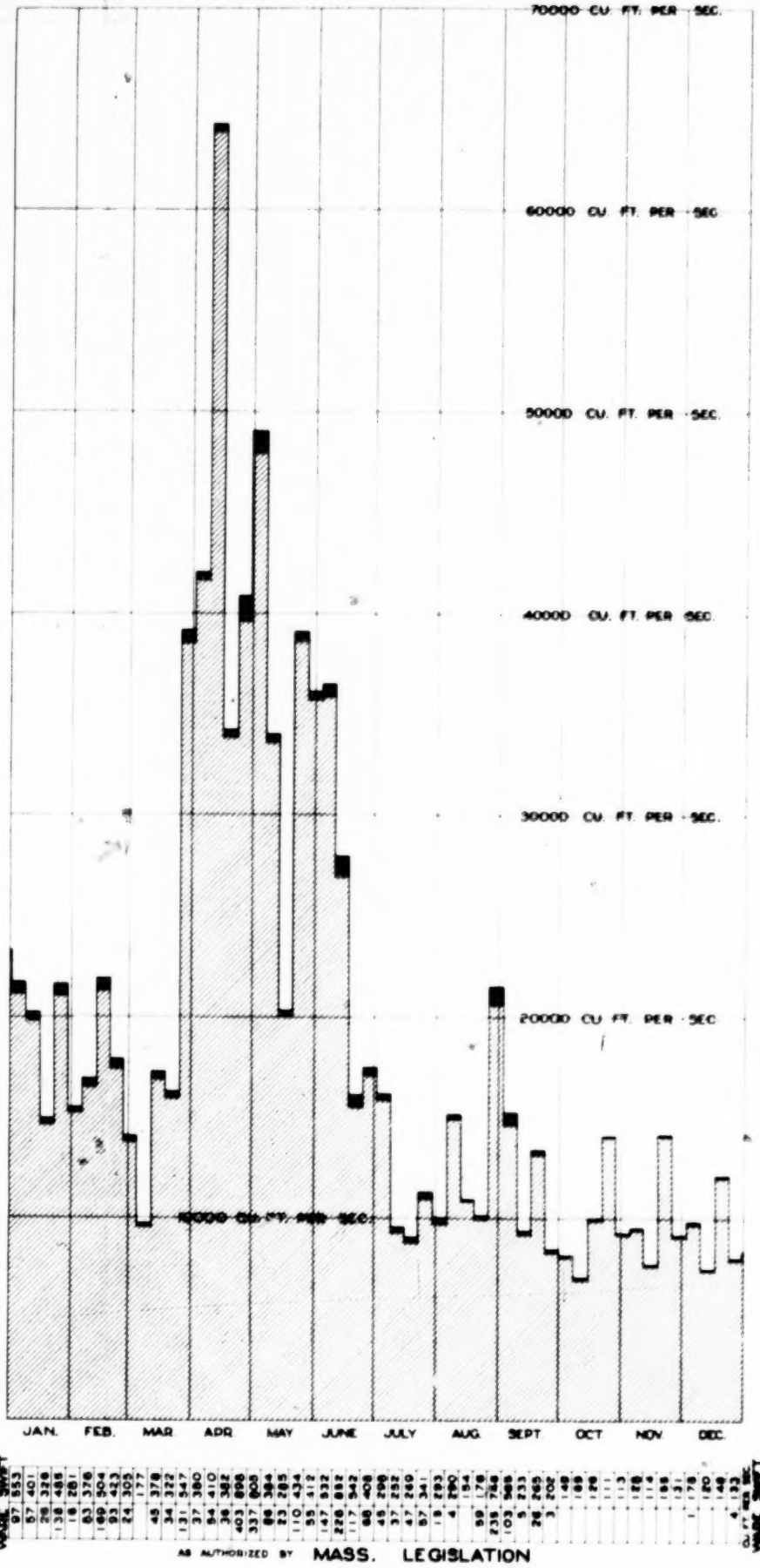
I think the test of validity to be applied to an authorization by the Secretary is whether the matter involved is germane to navigation, whether it has relation to that subject. Even Congress has no right to destroy navigable capacity and the principle which applies to the Secretary is the same which applies to Congress, viz: that his act must have relation to the control of navigation. This was the test stated by the court in *Wisconsin v. Illinois*, 278 U. S., p. 415. I do not think it can be maintained that every work referred to in Sec. 10 must be one whose sole design is to aid navigation. The Secretary is given jurisdiction over the whole range of structures and works [except those named in Sec. 9], from those designed solely to improve navigation to those like dams, booms, weirs, etc., etc., not designed to better navigation and which may or may not injure it. A large part of the function of the Secretary is to determine whether the structures last referred to injure navigation materially and to license them or not according to his determination. It seems to me that the determinations of the Secretary within this range are authorized by Sec. 10 and so authorized by Congress.

Moreover it is to be noted that the works authorized are to a certain extent in direct aid of navigation. The testimony shows that the critical period of navigation is during extreme low water and the Secretary's permit is on condition that water be added to the stream during that period. The proof shows that from 1913 to 1929 inclusive the Swift river reservoir, operated as required by the Secretary, would have increased the flow of the Connecticut 43.5 days during each year on the average, the number of days varying from 110 in 1913 to zero in 1922 and 1928, the last two being years of unusually high water.

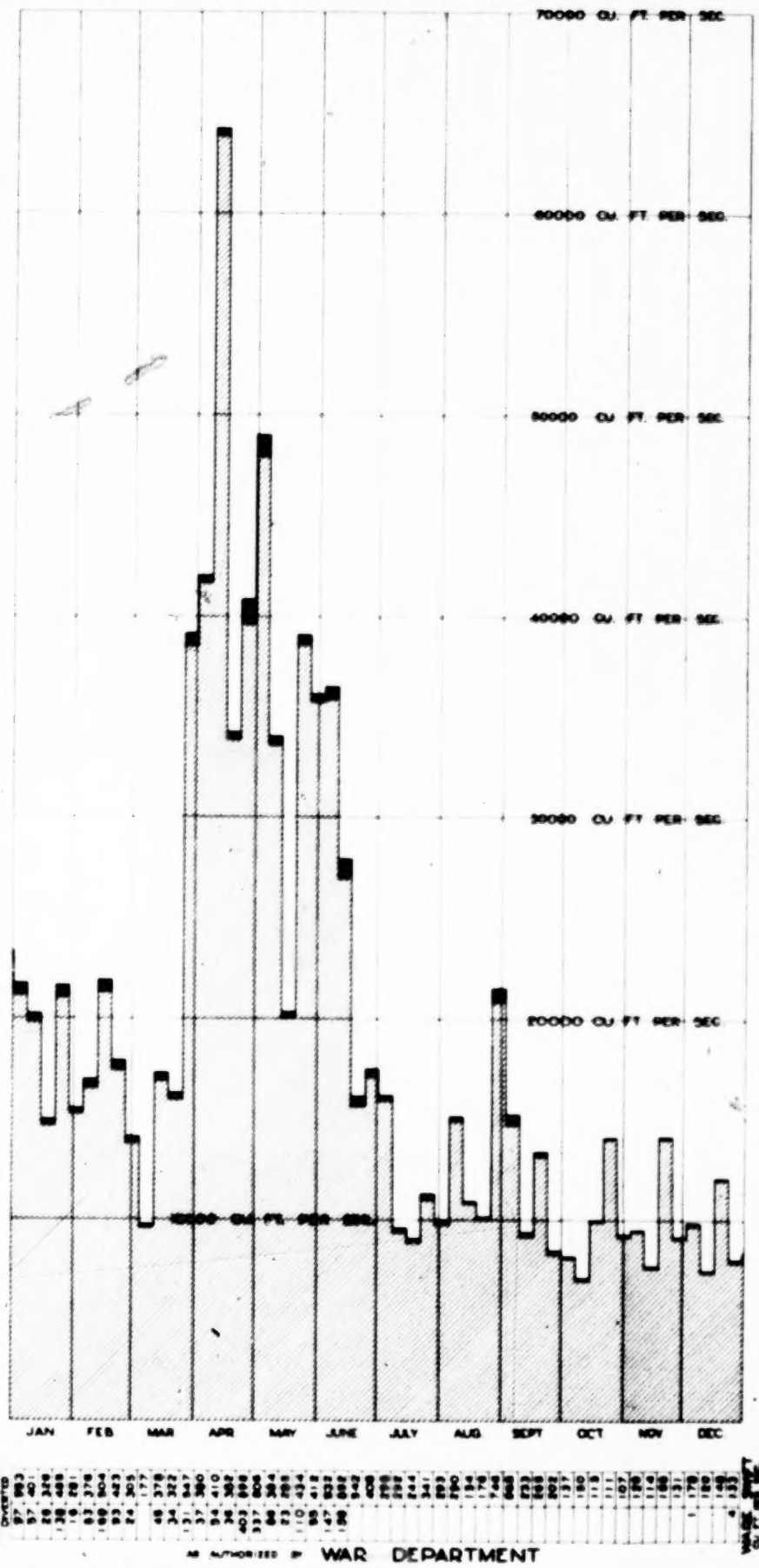
NAVIGATION—FINDINGS AS TO.

On the possibility however of the Secretary's permit being held inconclusive I will consider the testimony on navigability contained in the record. This consideration does not need to be lengthy. The substance of the testimony as to the commerce carried on has been indicated. The United States has aimed to maintain a channel of 10 feet over the numerous bars below Hartford. These have to be dredged out every year and the witnesses, who are shippers and masters of vessels in the trade, are in entire agreement in their story of difficulties at the lowest stages of water, when the depth on the bars at times falls even below 10 feet. This depth is considerably influenced also by the winds and tides as well as by the stage of water. There is no proof of difficulty in navigation at times when the stage of water is 12 feet or even 11 feet, 11 corresponding to an indication on the Hartford gauge of 3 feet. The discharge required from the Swift river reservoir during low water periods will somewhat benefit navigation. I cannot see how the diversion can injure navigation and therefore find that the proposed diversions will not interfere perceptibly or materially with the navigation of the Connecticut.

The proposed subtractions and additions to Connecticut river flow are shown in a large graph covering by weeks the whole period from 1913 to 1929 inclusive, defendant's exhibit 4. It was accepted as substantially correct by both parties and by all the witnesses. Each of the columns on the graph indicates a weekly flow of the Connecticut at the Massachusetts-Connecticut state line, that is an average flow expressed in cubic feet per second during the week shown at the foot of the chart. A solid white section at the head of a column scales the amount of water that would have been diverted during that



AS AUTHORIZED BY MASS. LEGISLATION



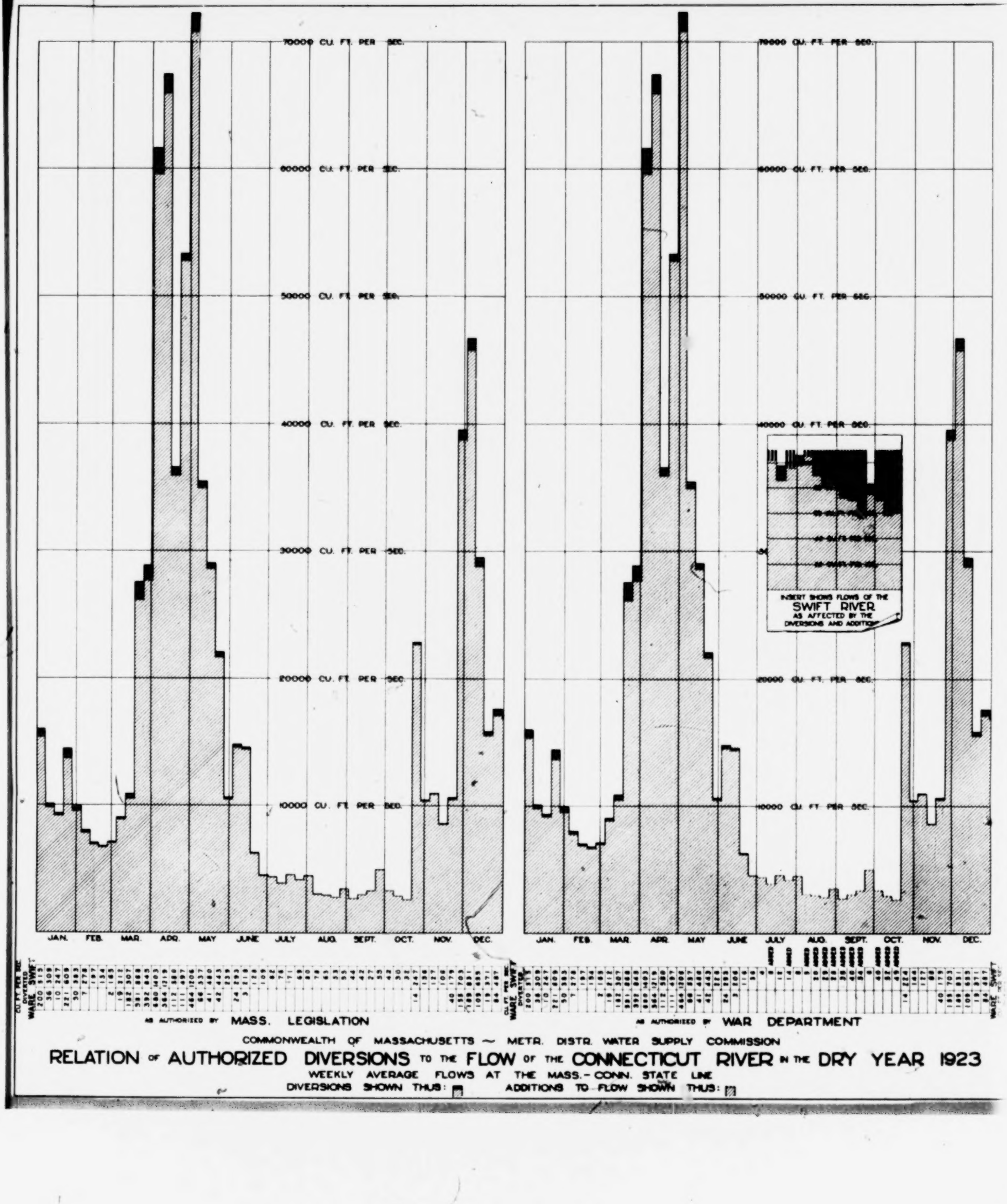
AS AUTHORIZED BY WAR DEPARTMENT

COMMONWEALTH OF MASSACHUSETTS ~ METR. DISTR. WATER SUPPLY COMMISSION

RELATION OF AUTHORIZED DIVERSIONS TO THE FLOW OF THE CONNECTICUT RIVER IN THE WET YEAR 1928

WEEKLY AVERAGE FLOWS AT THE MASS. - CONN. STATE LINE

DIVERSIONS SHOWN THUS: [ ] ADDITIONS TO FLOW SHOWN THUS: [ ] (NONE IN THIS WET YEAR)



COMMONWEALTH OF MASSACHUSETTS ~ METR. DISTR. WATER SUPPLY COMMISSION

RELATION OF AUTHORIZED DIVERSIONS TO THE FLOW OF THE CONNECTICUT RIVER IN THE DRY YEAR 1923

WEEKLY AVERAGE FLOWS AT THE MASS. - CONN. STATE LINE

DIVERSIONS SHOWN THUS: ▤ ADDITIONS TO FLOW SHOWN THUS: ▨

week from the Ware and Swift rivers under the Secretary of War's regulations. A solid line at the head of a column shows very slight diversion, too small to be indicated on a chart of this scale, while a dotted line at the head of a column means additions to a normal flow by release of water impounded in the Swift reservoir. To illustrate the showing of this graph I insert opposite this page a section of the graph for the dry year 1923 and one for the wet year 1928. The average proposed diversion of water per annum is agreed to be substantially two per cent of the flow of the Connecticut at the state line. The maximum diversions are at high water and amount to from 5 to 6 inches, that is at periods of very high water the stage of the Connecticut may be reduced 5 to 6 inches, at medium stages less, and at very low stages its flow is increased.

INUNDATED LAND.

The parties stipulated that in the Connecticut river bottoms there are about 9,500 acres of meadow land used for growing hay which are subject to periodical inundation by the river; that this acreage grows from two to three tons of hay per year which is used for feed of cows and horses and usually can be marketed, if carried over to spring, at about $26 per ton, or sold standing at substantially an average price of $12.50 per ton; that when this land is inundated it grows a hay crop without fertilization and the flood waters are a benefit in that they increase the crop of hay which can be grown without fertilization; that diminution in the height of flood water would be a detriment to such of the lands as thereby are not overflowed and that practically no crops other than hay are grown on the regularly inundated land.

It needs no testimony to prove that floods and inundations frequently cause damage. The Mayor of Hartford in this case

showed dykes built at considerable expense in Hartford to fend off Connecticut river floods. The benefit from inundation of the 9,500 acres of hay land is exceptional. The amount of injury to the hay crop likely to result from the Swift and Ware diversion was not proven,—probably is not capable of proof—and was left to conjecture. How much hay land would fail to be submerged because of the diversion is quite uncertain. The land owners who testified showed that the hay lands were not of uniform elevation; that sometimes small areas are not submerged resulting in a diminished crop.

The height of floods will be lessened from one to six inches by the proposed diversion. It seems certain that small pieces of hay land here and there in some years would fail, because of the diversion, to receive flood waters, which they would have gotten without it. But there is no attempt to show to what extent this would be true and it is impossible to determine from the evidence.

The lessening of spring floods will have its advantages and disadvantages. It will lessen some damages and increase others. On the whole I think the damage to the hay land is not shown to be of "serious magnitude;" and that such damage, far from being "established by clear and convincing evidence", is shown by no evidence making it possible of computation or proving that it is large.

POWER PROJECT.

Only one possible power development is shown. This is at King's Island in Connecticut near the state line where 4,000 horse-power is now developed at a 24-foot head. The company which owns this power has been authorized by the Federal Power Commission to build a higher dam to develop approximately 50,000 horse-power. This work so far as the testimony

shows has not been resolved on by the company, and so far as shown the required capital has not been subscribed or arranged for.

If these facts bring the power within the cases of *New York v. Illinois and Sanitary District of Chicago*, 274 U. S. 488, and *New Jersey v. Sargent*, 268 U. S. 328, pp. 338-9, injunction on this ground should be denied because no present use of the waters for power purposes will be disturbed.

But assuming that the cases cited do not apply; giving allowance for water released at times of low flow in accordance with the Secretary of War's requirements, the loss of power attributable to the diversion would amount to $7,920 per year valuing each kilowatt hour lost at 6 cents; $7,920 per year capitalized at 5 per cent is about $160,000; from this should be deducted $80,000 representing a saving in capital investment resulting from the required addition to water in low flow furnishing 1,000 additional horse-power at low stages; this increase of minimum power would cause a corresponding decrease in steam-power plant, which will be required to supplement the water in times of low flow. This $80,000 deduction was testified to by Mr. Weston Fuller whose testimony was not questioned.

Therefore it appears that if this water-power is developed to the extent of 50,000 horse-power the Massachusetts diversion of Ware and Swift waters will cause an injury to the power of $80,000.

I know of no objection (assuming that the immaturity of the power project is not fatal) to the court requiring Massachusetts to pay to the power company or its assigns $80,000 if and when the power is developed to the extent stated.

RUN OF SHAD.

It is shown that shad have been accustomed to run up the Connecticut river and its lower tributaries to spawn. This happens in the spring, generally in strong flowing water. The fresh water from the Connecticut in time of flood is described as going out two miles into Long Island Sound and attracting the shad. Connecticut is engaged in operating fish hatcheries for propagating shad and it licenses and regulates shad fishermen.

Some witnesses believed that a large freshet encouraged shad to come up the river. The Superintendent of Connecticut State Board of Fisheries and Game believed that a reduction in flood would be harmful to fish life, but as to whether the shad catch varied directly with height of floods the witness was not willing to commit himself. A graph showing statistics for the shad catch was introduced, complainant's exhibit 29. See also complainant's exhibit 30. The graph I think fails to prove that shad catches follow high May floods. This is also indicated by complainant's exhibit 29a, which was prepared by Massachusetts from the shad catch figures in complainant's exhibit 30 combined with the flood flows as found in the records of the United States Geological Survey and of the Holyoke Water Power Company. These charts lead to the inference that the variation in shad catch is due largely to elements other than mere height of floods. Such factors as temperature, time of flood, artificial propagation of shad, limiting and regulating shad fishermen and the fishing industry, existence of dams and other conditions. See also defendant's exhibit 12 showing shad taken each year from 1872 to 1929.

On the evidence I find that the lowering of flood water resulting from proposed diversions is not shown to be materially injurious to the shad run.

It was also contended that pollution in the Connecticut would be increased by the proposed diversions and that this would have a deleterious influence on fish life. For the present I pass the question of pollution to take it up under the next heading.

POLLUTION OF THE CONNECTICUT.

The testimony shows that the Connecticut river has been treated, like most of our rivers, with an utter disregard to its purity. Pollution both from sewage and factory wastes has been permitted both by Massachusetts and by Connecticut and the policy in those states appears to have been not materially different from the other states in New England. This is not a bill to abate the pollution. The issue is not raised in the case and Connecticut in such a bill could not come into court with clean hands. See *Missouri v. Illinois*, 200 U. S. 496, 518-520.

The bill of Connecticut sets forth that certain cities, towns, factories and riparian owners in Massachusetts discharge sewage and factory waste into the river. The contention is that such a condition necessitates the whole natural flow of the stream, including flood flow, in order to fight this pollution. Any diminution of this flow Connecticut says will seriously affect the public health, cause sickness, suffering and possible disease and irreparable damage.

On this subject as well as on the water and water supplies in northeastern Massachusetts yet to be considered some of the most eminent and fair-minded experts of the country gave testimony. I wish to testify to the qualifications, high intelligence and absolute fairness of these experts.

Their testimony was based on a great number of samples taken from Connecticut water during extended periods of time. The water is shown to be polluted. The number of colon

bacilli which it contains was the subject of much testimony which I do not think needs elaboration. Deposit of sludge beds at some places was also shown. It was agreed by all the experts that water in the polluted condition of the Connecticut is short of a full oxygen supply and the quality of the water to a large extent is indicated by its deficiency in oxygen. Oxygen operates to consume the pollution and doubtless flood waters operate to some extent to carry it out to sea. It was shown that the Connecticut river between the northern Connecticut line and a point about six miles below Hartford is greatly improved in condition notwithstanding the discharge of sewage by Hartford. The reason of this is that the water increases from the air its oxygen supply and oxygen is destructive of pollution. Two of the principal Connecticut experts on this subject were Professor Winslow of Yale and Dr. Rudolfs of Rutgers. The following is an extract from Professor Winslow's testimony:

DIRECT EXAMINATION

"Q. Now, you are acquainted in a general way with the Massachusetts legislation as to the abstraction of water authorized under that legislation of Massachusetts? A. In a general way, yes, sir."

"Q. You are acquainted with the restrictions imposed by the War Department? A. Yes, sir."

"Q. How much effect would the restrictions imposed by the War Department have upon the Connecticut River at the State line, assuming they are complied with? A. I don't think that the change would be sufficient one way or the other during the summer months to be detected by any methods at our disposal, either way.

"Q. It doesn't make any difference whether it is the Massachusetts legislation or the restrictions of the War Department? A. Just look at it from a broad—let me try to look at it not as an expert, but from a broad com-

mon sense standpoint at the beginning. Say you are putting in or taking out something well under five per cent. Now, then, none of these methods we are using on the river would check on samples taken half an hour apart within five per cent. In other words, I cannot conceive that the effect of these differences and the change in the condition at the State line could be detected by any means we now pursue.

"Q. What do you mean?

"The Witness: I mean if you take out five per cent of the water in the Connecticut River or five per cent of the oxygen, or if you put it in, put in five per cent more or take it out of that now reaching the State line, if you could take the river just above the State line and had a magnet and could pick out five per cent of the oxygen or put in five per cent more of oxygen, nobody would be able to tell the difference. If the experts on both sides of this case were there before and afterwards I doubt if they would be able to obtain results that would show a difference.

"If you take out ten per cent, I am inclined to think you could probably find a damage or a benefit, depending on whether you are putting it in or taking it out. Then if you get 20 per cent, I am rather sure you would have a rather definite and appreciable and serious result if you diverted out of this flow. (This flow is around 3,400 million gallons average during that summer.) Now if you had taken out 500 million gallons out of that thirty-four, out of that pure water, I think there would have been a very serious effect on the water at the State line and it would probably have had a greater effect on the oxygen, and would have probably been sufficient to push that river over the danger line and make it an open sewer instead of a stream. But if you took out four hundred, you could probably detect it analytically; it might be a little less pure. If you took out a hundred thousand or two I don't think that even a group of eminent experts could detect with any certainty any effect. We can say that every quart we take out makes it worse or every quart we put in

makes it better, but within the limits we can use in analyzing you would have to have 10 per cent change, let us say, one way or the other before you could get anything that would be really significant.

"Q. So that so far as the actual condition of the water is concerned it isn't going to be materially affected one way or the other? A. I don't think so.

"Q. It can't be any better and you don't think it would be any worse? A. I don't think either diversion under the War Department ruling or diversion under the Massachusetts statute, as I understand it, would make any detectable difference in the water at the State line.

"Q. At present? A. At present.

"Q. Now you say that if there was a contribution during the low flow period of perhaps 10 per cent of oxygen from pure water it would have an appreciable effect for the good of the stream at the State line? A. I think it would. I think you would probably find that that was a detectable difference.

"Q. So that if the compensation from the diversion of the Ware and Swift rivers amounted to 10 per cent of your oxygen in spite of the amount which is authorized to be released under the War Department's restriction, you would have a substantial benefit instead of a situation which does not change the present situation? A. I think anything that added 10 per cent to the pure water in the Connecticut river would benefit it appreciably."

CROSS EXAMINATION.

"Q. Supposing that the flow of the Swift river during that period was 1.3 per cent of the Connecticut's flow at the state line, would that amount fall within the quantities which you described as negligible and non-detectable? A. I think it would, yes, sir.

"Q. And as I understood you, neither you nor the experts on our side would be able to determine with any satisfaction to themselves or to yourself, what the effect of

that was, that addition or subtraction? A. Assuming it to be 1.3 per cent of the total flow of the river?

"Q. Of the total flow of the river? A. Yes; I think that is true.

"Q. As I understood you, that would be true probably up to a contribution or a diversion of about five per cent? A. I should say somewhere around there, yes.

"Q. And after five per cent it would become detectable and at 10 per cent I think you stated that it would be detectable? A. Yes.

"Q. And at 20 per cent it would be not only detectable but serious? A. Yes, sir.

"Q. And that applies with reference to the amount of oxygen in the water? A. Yes, that applies to water which is relatively pure. I am assuming in that, that the water diverted is water diverted at the upper part of the stream before it is heavily polluted. If you take out one-fifth of the water at the state line you would not change the percentage relations at all.

"Q. Would you say that that same conclusion was true as regards the public health? A. Well, yes, I should, because you would have to have an enormous change in quality on the one hand and an enormous improvement, to make the river safe for bathing. You would have to have a very large change for the worse to make it impossible to purify it by storage, chlorination, or filtration. I should say then that a change of five per cent either way was not of practical moment.

"Q. Either as regards the purity of the water or the effect on the water with respect to public health? A. Yes, sir. • • •

"Q. If there would be any determinable difference how much difference do you think there would be in the cost of purifying the Connecticut river at Hartford, in the way you have suggested by storage, filtration, and chlorination, before and after this Ware and Swift river diversion? A. I have tried to indicate that the difference due to the abstraction of one per cent or two per cent of water is so

slight that it cannot be measured in any concrete way. It is a purely theoretical damage or advantage when we are within these limits.

"Q. For any purpose? A. For any purpose that I know of we cannot determine within one or two per cent * * *"

Doctor Rudolfs' testimony did not differ very materially from that given by Professor Winslow. He agreed that quite a substantial addition or diminution of the Connecticut flow would be necessary to make a noticeable difference in pollution. Professor Earle B. Phelps of Columbia, Mr. Robert Spurr Weston and Mr. George W. Fuller, all called by Massachusetts, examined over 4,000 samples of Connecticut water and tributary waters taken at 15 different stations during a period of about six months. They all testified that the diminution in flow resulting from the proposed diversions would have no perceptible effect on pollution.

I think the plaintiff has failed to prove that the proposed diversion would perceptibly increase Connecticut river pollution, and consequently that there is no satisfactory proof of material pollution damage to the Connecticut to result from installing and operating the proposed Ware and Swift works.

II.

The next inquiry is whether Boston ought to be compelled on the evidence to take its water from the eastern portion of the state. Thus far the findings and statement of evidence have been confined to effect on the Connecticut river of the water diversions proposed by Massachusetts. On that branch of the case my conclusion is that Connecticut has failed to show any important and very considerable damage (unless it be to the power plant which can be paid for in a

definite sum of money). But I think it must be admitted as witnesses testified that any diminution of the flow of the Connecticut causes damage to some extent; some damage although it may be small and incapable of estimation. And were it made clearly to appear that Boston and the other population in northeastern Massachusetts have an abundance of perfectly good water at home, that might be a good reason why equity should enjoin their going to the Connecticut watershed and thereby causing a neighboring state even a small damage.

In this view I have regarded as important the allegation of Connecticut in an amendment to the bill that the Boston District as well as the neighboring population can well be supplied with good water from the eastern part of the state. Many civil engineers, water engineers, and water and sewage experts were examined upon this question and many exhibits were introduced.

The first fact, and I think it quite important, is that the people of Massachusetts have decided against the eastern water supplies by passing the Ware and Swift legislation. These acts were the result of long-continued and careful study commencing in 1895. In that year there was a report, House Document (1895) No. 500, by the Massachusetts State Board of Health. As a result of this report the present Wachusett reservoir, in which are stored the waters of the upper Nashua river was adopted. A second report was made in 1922, House Document No. 1550, a Report of Joint Board of Water Supply Needs and Resources. This report embodied the recommendations of the Massachusetts State Department of Health and the Metropolitan District Commission, acting jointly, as to the appropriate method of extending the Boston Metropolitan District water supply. The report recommended extending a tunnel westwardly from the Wachusett reservoir to the Ware, thence further west to the Swift where a reservoir was to be

built in which to store waters drawn from these streams. This report was not acted upon by the legislature at once and another commission known as the Gow-Hazen Commission examined the situation and reported in favor of taking water from the Ware river together with certain eastern Massachusetts sources (including the Assabet, Ipswich, and Sudbury rivers). This report raised objections from the Ipswich valley, from Concord, and from towns on the Assabet. Finally the legislature definitely rejected the eastern supplies including the Merrimack and passed the acts of 1926 and 1927 for taking water from the Ware and Swift. I think these investigations and the legislative acts show a public sentiment against the eastern water supplies and make a *prima facie* case that these supplies are inadvisable, either because inadequate or unfit. However the engineers and other experts called by Connecticut have made a strong effort to show that this legislative determination is wrong and that the northeastern portion of Massachusetts has abundant supplies of water of good quality for Boston and the northeastern population of the state for the next 50 years and more. The southeastern part of Massachusetts, including Cape Cod, seem to have sufficient supplies of water for itself and was not brought into the case.

Mr. Jacobs a civil engineer, of Morris Knowles & Company of Pittsburgh, submitted plans for supplying Boston and northeastern Massachusetts for at least 50 years with water from the Atlantic watershed in Massachusetts.

The serious question is whether the water supplies are there and whether they are of good quality. There is no material dispute as to the present and future requirements of water. Professor Winslow offered a suggestion that the future growth of population was over-estimated. He may be entirely right in general, but he apparently was not speaking of northeastern Massachusetts apart from other portions of the state. It seems

to me we cannot ignore that such a territory within convenient motor car distance from Boston is likely to increase much more in population than the state at large.

Defendant's exhibit 32 is designed to show that by 1970 northeastern Massachusetts, including Boston and vicinity, will have a deficit of 178,000,000 gallons a day, and that its demand for water will then be 467,000,000 gallons a day. This exhibit shows populations, supplies and consumption requirements for the years 1929, 1970 and 2000, for the whole northeastern portion of Massachusetts. There is no large controversy as to the water requirements, except that the growth of population for a long term is quite uncertain. In considering the case I have ignored the population estimates for the year 2000 but find that the estimates for 1970 seem within the reasonable probabilities. The following table is made up from the exhibit.

	1929	1970
Total population	2,860,000	4,572,000
Total million gallons a day water supply resources:		
District (not counting Ware and Swift)	147	134
Local sources (of District Group)	61	38
Local sources (of outside groups except from the Ipswich)	50	32
Ipswich river	70	70
Assabet river (emergency supply)	15	15
	343	289
Total consumption requirements:		
District	197	373
Outside the District	47	94
	244	467
Surplus*	99	
Deficit		178

*Distributed over a number of independent communities with no connections making their surpluses mutually available.

The testimony on behalf of Connecticut before referred to urged that the following sources are available in eastern Massachusetts in addition to those named in defendant's exhibit 32:

	Million gallons a day
Shawsheen river	30
Lower Sudbury river	17
South Sudbury (in addition to that now used by Massachusetts)	27
Assabet river (in addition to the 15 million gallons a day admittedly available as an emergency supply)	20
Total	94

The sources last named totaling 94,000,000 gallons a day will be insufficient to meet the 1970 probable deficit. Besides this Massachusetts urges objections to the plan.

Witnesses on behalf of Connecticut put forward the Merrimack river which they urged is a practically inexhaustible supply to be used, either in lieu of the 94,000,000 gallons a day plan, or to make good any deficit should that plan be adopted.

The first plan mentioned involves a number of minor sources (Shawsheen, Lower Sudbury, South Sudbury, and Assabet rivers). The Merrimack river plan involves a diversion of 200,000,000 gallons a day from the Merrimack river at Tyng's Island, which is in Massachusetts about three miles below the New Hampshire line.

15 WATERSHED PLAN.

The first plan (see complainant's exhibit 32) involves combining water from 15 watersheds, 9 of them being small watersheds on the Assabet river. The Assabet sources contain a

total drainage area of 58.8 miles and the plan involves carrying the water to the Wachusett aqueduct partly by gravity and partly by pumping. The watersheds (indicating them by the capital letters shown on the exhibit) show as follows:

Watershed	Drainage area	Size of reservoir	Elevation
A	11.3 sq. mi.	212 million gallons water to be pumped into Reservoir B-1	230
B-1	5.3 sq. mi.	848 million gallons water pumped to Wachusett Aqueduct	330
B-2	4.3 sq. mi.	716 million gallons water flows into Wachusett Aqueduct	330
C	15.1 sq. mi.	38 million gallons water pumped into Wachusett Aqueduct	230
D	1.6 sq. mi.	65 million gallons water to flow into Wachusett Aqueduct by gravity	325
E	4. sq. mi.	48 million gallons water to flow into Wachusett Reservoir by gravity	300
G	6.5 sq. mi.	193 million gallons water to be pumped into Reservoir E	300
H	7.7 sq. mi.	264 million gallons water to be pumped into Reservoir I	320
I	3. sq. mi.	180 million gallons water flows by gravity into the aqueduct	280

The South Sudbury supply involved in this plan being for the most part polluted would have to be filtered or otherwise treated before use. Mr. Jacobs estimated a supply from this source of 15,000,000 gallons a day, which Massachusetts says is only 11,000,000 a day.

Mr. Jacobs' plan involves taking water from the Lower Sudbury to Hobbs Brook reservoir (at present used by the city of Cambridge for its water supply). The proposal is to increase the size of the Hobbs Brook reservoir from its present capacity of 2,000,000,000 gallons to 8,265,000,000 gallons. By this means the Hobbs Brook supply would be increased about 27,000,000 gallons a day, the water coming from the Sudbury river below Framingham reservoir No. 1 and below lake Cochituate.

Water from the Shawsheen river which rises in Lexington and flows in a general northeasterly direction joining the Merrimack below the city of Lawrence is to be gathered in two reservoirs (Upper Shawsheen res. and Lower Shawsheen res. on the exhibit). From these reservoirs the Shawsheen water is to be pumped into a large reservoir on the upper waters of the Ipswich. The Ipswich flows in a northeasterly direction to the ocean near the village of Ipswich. Mr. Jacobs testified that a yield of something over 100,000,000 gallons a day could be obtained by this combination of Shawsheen and Ipswich waters. It is admitted that to preserve the quality of the water in both streams below the diversion, 10,000,000 gallons a day must be released on the Ipswich river and 3,000,000 a day on the Shawsheen. The plan involves filtration of the water at the Ipswich dam, from which it would be pumped to Spot pond, one of the present distributing reservoirs for the city of Boston. Because of the natural claims of towns in Essex county to the use of Ipswich river water Mr. Jacobs computed only 78,000,000 gallons a day as being available for Boston.

The Massachusetts experts unanimously testified that the collection of small supplies from so many sources involving so much pumping made an undesirable and impractical scheme. Doctor Rudolfs, an expert for Connecticut, conceded the force of this and expressed his preference for one point of intake as being much simpler. Doctor Gregory of John Hopkins, one of the leading experts called by Connecticut, said "Other things being equal I think it is simpler to operate a works where you have a large unit than a number of small units." Professor Winslow called by Connecticut also said that to his mind the sounder plan is development of the Merrimack river.

Frank A. Barbour, an engineer of large experience specializing in water supplies and sewage, as a witness for Massachusetts said:

> "As presented by Mr. Jacobs in the order of their proposed development, the scheme included the filtration of the South Sudbury River, the Shawsheen-Ipswich development, and third the Lower Sudbury-Hobbs Brook development. Fourth, the headwaters of the Assabet and the filtration of the Wachusett supply. In the first place it is obvious that this project is to be substantially discounted by the multiplicity of sources and the resulting burden of coordinating them in actual use. The complete project involves 13 different new catchment areas; two on the Shawsheen, one on the Ipswich, one on the Lower Sudbury, and nine on the Assabet. It involves nine new pumping stations widely separated; it involves four filtration plants, also widely separated; of the 58.8 square miles of watersheds in the nine little Assabet developments the run-off of 45.9 square miles, or about 80 per cent, is to be pumped, and only the run-off of 12.9 square miles, reaches the Wachusett aqueduct by gravity. Now this is quite a different development from that suggested by Mr. Stearns in 1895, in which case he was simply going to take such part of the Assabet as would flow into the Wachusett acqueduct

channel by gravity. It is also to be noted that the average head against which the five Assabet pumping stations of 253 million gallons daily capacity must operate approximate 92 feet. That is a pretty high lift for raw water, to lift raw water up into a system. In my opinion, therefore, no detailed analysis is necessary to show that this widely-scattered small unit scheme is substantially discounted in value by that very fact."

This statement of Mr. Barbour is illustrative of the testimony of several witnesses called by the defendant.

In general the Connecticut witnesses regarded this scheme as inferior to taking water from the Merrimack. It seemed to be the view of all the witnesses of both sides that the water obtained under this scheme would have to be filtered or otherwise treated. Doctor Rudolfs testified that he thought the treatment proposed (some storage, filtration and chlorination) would furnish a safe water, but admitted that other things being equal he would prefer a supply of pure water to polluted water.

It is shown that the Ware-Swift water from the standpoint of quality and the Ware-Swift project from an engineering standpoint are much superior to the plan in question. The Swift river basin is an ideal site for a reservoir to hold 380 to 420 billion gallons. This large holding capacity can be secured by flooding a minimum quantity of cheap land and by a dam of minimum cost. The population of the Swift-Ware district has for a considerable time been decreasing. It is a sandy, rough and barren country. The waters are of good quality.

Several of the Massachusetts witnesses testified that the whole district in question from the Assabet to the Ipswich is so close to Boston as to be certain to have large increases in population. Mr. Barbour thought a supply of soft water could

be obtained from this project but it would be "a supply which carries the necessity of continuous high-grade supervision as it is open to all the hazards involved in the human factor. * * * There will be tastes and odors periodically which will make the supply decidedly less acceptable than if obtained from the Ware and Swift." Mr. Eddy of Boston, a well known engineer, testified that the plan was distinctly superior to the Merrimack as to quality of water. But he regarded it as an inferior source compared with the Ware-Swift, a source which is going to be extremely difficult to maintain at anything approaching satisfactory sanitary conditions in the future. James F. Sanborn, for 13 years an engineer for New York in developing the Catskill water supply, testified that the waters involved are open to the general objection that they are already well polluted and with an increasing population there will be a constant tendency to increased pollution, which he said meant that the population would probably be faced with abandoning some of the areas after a few years. He objected to the multiplicity of small units because it involved the human equation in so many portions of its operation.

It is recognized and admitted by Massachusetts that there is available on the nine Assabet watersheds a certain quantity of water, but Mr. Kennison, the Designing Engineer of the Metropolitan District Water Supply Commission for many years, intimately acquainted with these waters, said it was possible to take some of the Assabet headwaters, but recommended they should be regarded solely as an emergency source capable of producing only between 11 and 15 million gallons a day (instead of 35 million gallons a day as estimated by Mr. Jacobs). He and Mr. Westen Fuller said that the population about these waters was sure to increase. It also appears that there are important factories at Maynard and one or more other

points below the diversion which depend on the Assabet for process water, and whether the proposed diversion would infringe on their requirements was left by the testimony quite uncertain.

Objection was urged by Massachusetts civil engineer witnesses to the reservoirs proposed on the Ipswich, the reason being that they would be located upon the Wenham swamp. A swamp or peat bottom is regarded by the Massachusetts witnesses as highly objectionable because of its tendency to cause leakage, to create color in water and encourage growth of weeds which makes filtration difficult. Testimony was given for Massachusetts that the Ipswich water handled as proposed would be relatively of a high color and objectionable from the point of odor and taste. Also that a large algae growth was to be expected which would involve treatment of the water with copper sulphate, possibly several treatments during a year.

The surrounding territory (Manchester, Gloucester, Rowley, and Newbury for example) is growing rapidly owing to good roads and increased use of automobiles. One town, Wilmington, has increased 50% in the last five years. Mr. Weston Fuller and other witnesses thought it a great mistake to develop the Ipswich supply for Boston and vicinity on account of the dense population immediately in and adjacent to the watershed and about the proposed reservoir. Some of the witnesses definitely stated that this supply, if developed, would in their judgment have to be abandoned or curtailed before many years because of the hazard from pollution.

Like objections were raised to the Shawsheen water, i. e., the presence of swamps and the increasing population.

The increased South Sudbury yield estimated by Mr. Jacobs as 17,000,000 gallons was subjected to the same general criti-

cism. An automobile trunk line from Boston to Worcester runs through the area and another road between the same points runs very close to it. The Boston & Albany Railroad runs through the center of the lower portion of it. It is very swampy and yields a highly colored water. This source of supply, once used, has already been abandoned by the Boston Metropolitan District because of the large population upon the watershed and the consequent pollution.

The lower Sudbury-Hobbs Brook development was subject to similar criticism. This water is in a district of towns and growing population. The present population was said by Mr. Goodnough to be 800 per square mile. Such towns as Framingham are in this watershed and the opinion was expressed that Framingham would soon greatly increase in population.

I find from the evidence on this subject that whilst Boston might make available a considerable amount of water from the sources referred to and in the manner referred to, or in some other manner, most of the water is of a quality much inferior to the Ware and Swift and that the project is inferior from an engineering standpoint to the reservoir and tunnel which the Ware-Swift development involves. It is also I think certain that whatever water might be realized from the sources in question would be in the first place an inadequate supply and fill only a part of the requirements, and would be in the second place a supply largely of uncertain duration which in whole or in part might have to be thrown away in the future.

MERRIMACK RIVER PLAN.

Coming now to the second plan presented by Mr. Jacobs, namely, that of taking water from the Merrimack. In listening to the Connecticut experts about the fifteen watershed plan, one could not but feel their lack of enthusiastic sup-

port for that plan. It is quite the contrary when we come to the Merrimack. The Connecticut water experts, and they are men of the highest qualifications and character,—Professor Winslow, Doctor Gregory, Doctor Rudolfs, and Major Whitman,—whole-heartedly endorse the Merrimack as a water supply for Boston. And on the other hand as many witnesses of equally high qualifications and character called by Massachusetts utterly condemn the Merrimack. I think the experts on water and pollution called by the plaintiff and defendant are equally competent and honest in their views. The difference between them seems partly to be a difference between two schools of thought. One looks most favorably on the sinner repentant, the other will have none of him except on compulsion. The one school has the fullest confidence in the processes involved in modern treatment of polluted water and lays less stress on pure source of supply. It suffices them to feel that water will be delivered to the consumer pure. The other school is skeptical about the infallibility of water purification processes and seeks waters that are pure at the source. They advise all cities and municipalities to obtain pure waters wherever practical instead of treating polluted waters.

Mr. Barbour had this to say about the Merrimack:

> "A. I think the first thing that stands out in the use of the Merrimack is the necessity of taking it immediately below the New Hampshire line, which at once emphasizes the fact that it is taken at a point where Massachusetts has no control over the amount of sewage or industrial waste which may be admitted to the stream. I take it there is not much necessity of emphasizing the population in the Merrimack Valley, but in 1920 there were some 350,000 people, of which 130,000 were in the three cities of Nashua, Manchester and Concord, located on the main stream at

distances of 20, 25 and 45 miles above the proposed intake, and all of the discharge of these cities enters the stream without treatment.

"Q. When you say 350,000 population, you are referring to the portion of the watershed above the intake? A. Above the proposed point of intake at Tyng's Island.

"Q. Have you any idea of what that population may be in a reasonable period of years? A. I think half a million people would be entirely reasonable to estimate within a period which might well be taken into account in the present case.

"We have knowledge of some 75 plants on the river, 25 paper mills, three tanneries, one rendering works, two cellulose products works, 11 cotton mills, 25 woolen mills and eight gas works. That, of course, does not include all such plants, as we have not had the opportunity of making a complete checkup. The majority of those plants are in New Hampshire.

"We, therefore, start with the Merrimack as a stream highly polluted by sewage and industrial wastes, the control of which lies in another state, and the proposed intake being immediately below the state line.

"Q. What is your opinion as to the prospect of change in the volume of pollution in the next 40 years, say? A. I cannot see it in any other way than that there will be a normal increase in pollution.

"Q. What is your judgment about the economic utilization of such a river as the Merrimack for industrial purposes? A. I think the Merrimack must always be a drainage artery. It has always been so recognized. Such recognition has been registered by the Massachusetts Legislature in taking this stream out of the control of the State Department of Health within the limits of Lowell. I believe that tendency and the economic necessity require that rivers shall be recognized as carriers of waste within certain limits."

Elsewhere in his testimony Mr. Barbour condemns the proposed reservoir at Foster-Martin ponds and those on the Ipswich.

He says the best modern practice is to choose where possible headwaters of streams instead of the lower polluted waters and names cities which have acted on this theory. He further says about the Merrimack supply:

> "Q. Now as to the working operation of the various works designed for this treatment, what is your opinion as to the probable results? A. I think that with 100 per cent success in operation the plant will give an entirely safe water, a water that outside of the danger of these organic tastes and odors, which periodically will make the water unacceptable to the consumer, that a safe supply and an acceptable supply outside of those periods can be furnished. I think that the project is open, because of the particularly polluted character of the water, is open to always-existing objection or danger of breakdowns in the filter plant. Such things do occur both in the operation of filter plants and in the chlorination process. Within a month we have had a shut-down of ten days at Cambridge right out here a few miles from where we are sitting, due to a breaking of a force main at the plant, entirely out of the control of the operator of the plant. The plant was shut down for ten days.
>
> "Q. What do you think of the chances of 100 per cent operation efficiency? A. I think that is not possible.
>
> "Q. Is that more serious in the case of water requiring all this treatment than in the case of a water of purer quality to begin with? A. That is of course obvious, that the necessity for the highest degree of supervision and success in operation depends on the degree of pollution of the raw water."

and elsewhere:

> "A. I think it is entirely possible to get a safe water from the Merrimack River by the proposed treatment, as-

suming the highest grade of supervision. I think there is a a danger of break-down, perhaps at long intervals, whereby there might be more water get by that would not be safe.

"I think there will be, during the summer season, the continued probability of tastes and odors which would make this water unacceptable intermittently, to the consumer. I think there is a particular danger of industrial waste on the Merrimack River which, if they do not exist today, may develop at any time and which will produce tastes and odors which are very difficult to remove by treatment and which are simply emphasized by chlorination, due to the formation of chloro phenols, which are even worse than the original taste and odor.

"I think the Merrimack-Ipswich scheme involves to a maximum degree the human factor and, in point of comparison with the Ware-Swift, as an operating plan, they are not in the same class and cannot be made so."

Mr. George W. Fuller said:

"The Master: I would like to know directly, in your own way, what you think of the Merrimack river supply for the Boston Metropolitan District.

"The Witness: I think it is a very poor one. I find it has weak links that you could not control at all times, and when those links give away you are going to give them unsatisfactory water, and it is also a more expensive supply, in my opinion, than the Ware-Swift proposition.

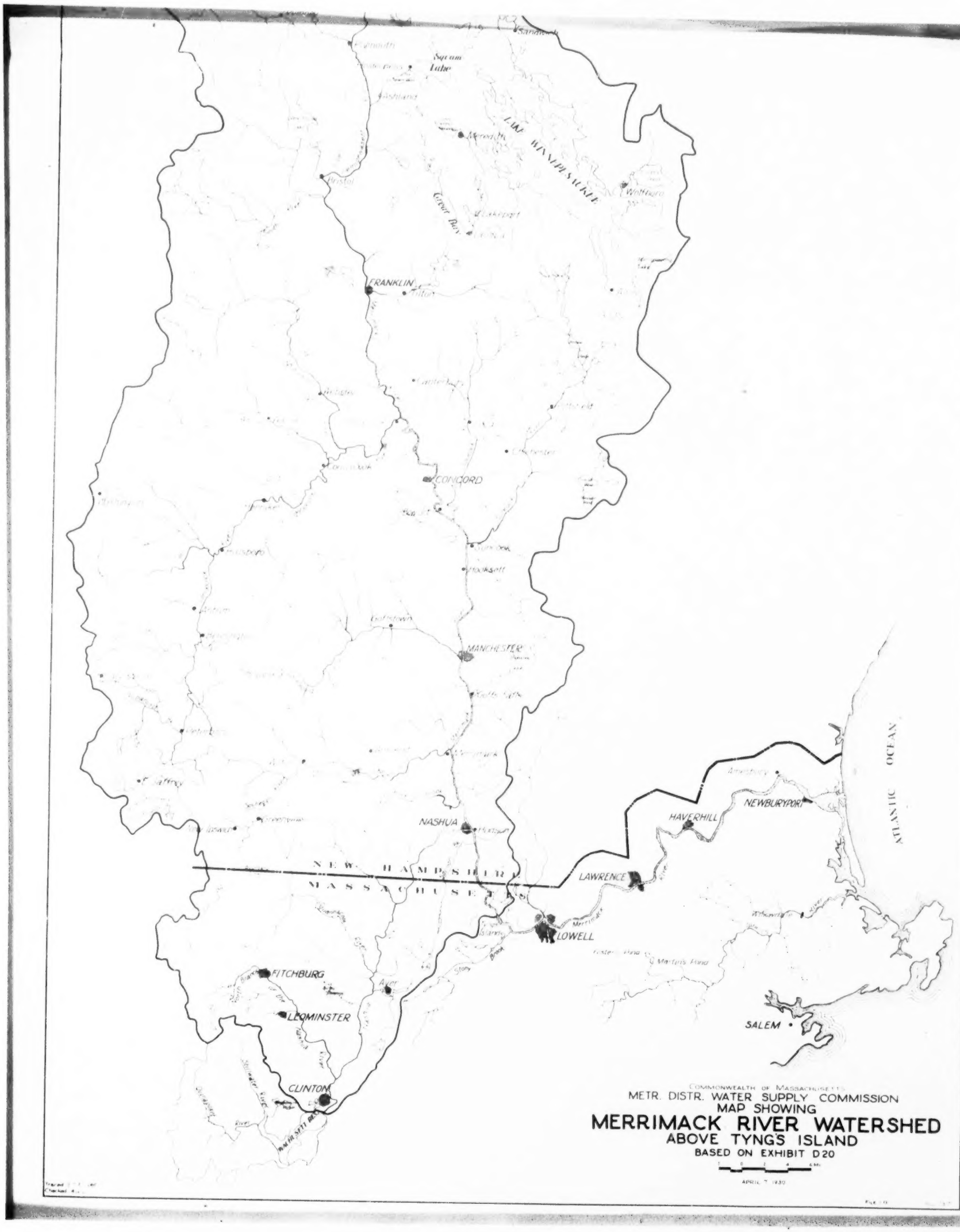
"The Master: Looking at the future, 30 years ahead, and considering the Merrimack with reference to that feature, what do you say?

"The Witness: Well, I think that it becomes then less and less desirable because here is a valley which has been devoted exclusively to various industries, which has an established labor market, an established set of facilities for mills and water power, and it seems to me it is bound to grow, that labor market is not going to go by unoccupied, and what those particular waste products may be, I don't know. Therefore, there is a question of doubt in my mind

as to whether you can get a suitable water supply, from the Merrimack river. But I am not looking at that, your Honor, from a standpoint of what happens within 60 or 90 or four months or six months storage reservoirs; but what will happen when those reservoirs are not behaving well and you get these slugs and paper mill wastes or other trade wastes washed out from behind these mill dams, and getting down to a point where they will actually overtax the facilities which are now available for purifying the water. In other words, it is not the average, ordinary, every day problems of treatment works in connection with storage reservoirs receiving water from the Merrimack river at Tyng's Island. It is a question in my mind what are those weak links when you get a breakdown in the process and you give the people, by getting objectionable tastes and odors, water that is uncoagulated, in getting it markedly unsatisfactory to the consumers of the Metropolitan District, and I don't believe it is possible for anyone to say that they can be reliably treated. That is exactly the point that I want to stress in regard to these weak links, these lacks of performance of the human element, the lack of fidelity in human performance, when the sleepy man at 3 o'clock in the morning lets things go wrong; the lack of jurisdiction in New Hampshire of Massachusetts; the lack of control of industrial wastes. Obviously the industrial establishment is going out in trade in a competitive way and using dye products and arrangements which will let them use their industry to advantage. They are not going to control those wastes as a thing, practically speaking, that is reliable.

"The Master: You don't disagree with the witnesses who have testified that from a scientific view it is entirely possible to make a wholesome water out of the Merrimack flow?

"The Witness: Well, as a sunshiny day problem when everything goes fine, I will say I do agree, but I don't think that enough significance has been attached to the weak link when the stormy and bad-acting periods come"


Sqw am Lake
LAKE WINNIPESAUKEE
Wolfeboro
Bristol
Great Bay
FRANKLIN
Tilton
CONCORD
MANCHESTER
NASHUA
HAVERHILL
NEWBURYPORT
ATLANTIC OCEAN
NEW HAMPSHIRE
MASSACHUSETTS
LAWRENCE
LOWELL
FITCHBURG
LEOMINSTER
CLINTON
SALEM
COMMONWEALTH OF MASSACHUSETTS
METR. DISTR. WATER SUPPLY COMMISSION
MAP SHOWING
MERRIMACK RIVER WATERSHED
ABOVE TYNG'S ISLAND
BASED ON EXHIBIT D20
APRIL 7, 1930

MANCHESTER
CONCORD
FRANKLIN
Tilton
Bristol
Laconia
Plymouth
Hillsboro
Peterborough
Keene
Claremont
Lebanon
Hanover
Littleton
Berlin
Colebrook
Lancaster
Whitefield
Rochester
Dover
Portsmouth
Exeter
Hampton
Salem
Nashua
Milford
Amherst
Concord
Franklin
Laconia
Plymouth
Lebanon
Hanover
Littleton
Berlin
Colebrook
Lancaster
Whitefield
Rochester
Dover
Portsmouth
Exeter
Hampton
Salem
Nashua
Milford
Amherst
Winnipesaukee
Squam
Lake
Newfound
Lake
Connecticut
River
Androscoggin
River
Merrimack
River
Piscataqua
River
Saco
River
Ammonoosuc
River
Pemigewasset
River
Contoocook
River
Suncook
River
Lamprey
River
Cocheco
River
Isinglass
River
Oyster
River
Lake
Winnipesaukee
Lake
Winnisquam
Lake
Newfound
Lake
Squam
Lake
Connecticut
River
Androscoggin
River
Merrimack
River
Piscataqua
River
Saco
River
Ammonoosuc
River
Pemigewasset
River
Contoocook
River
Suncook
River
Lamprey
River
Cocheco
River
Isinglass
River
Oyster
River
Lake
Winnipesaukee
Lake
Winnisquam
Lake
Newfound
Lake
Squam
Lake
HAVERHILL
NEWBURYPORT
Amesbury
ANTIC OCEAN

The Merrimack is a polluted river. It drains a large watershed mainly in New Hampshire but partly consisting of the Nashua watershed, the major part of which is in Massachusetts. Opposite this page is a map of the Merrimack and its valley. It is a district of large population and enormous factory development, the larger part of which is in New Hampshire. There is no question about the pollution of the water. There is no certainty of its improvement and no certainty that it will not become more polluted.

I have been much interested and impressed by the evidence of the water experts which puts it beyond question that polluted water by proper treatment may be made hygienic. The experfts convince one that even sewage by proper treatment makes an innoxious beverage.

Also I find, and there is no dispute on the subject, that many cities of Europe and of this country are using water probably as heavily charged with pollution as the Merrimack. London, England, Louisville, Cincinnati, St. Louis, Kansas City, New Orleans, are among these cities. But only one city was mentioned (Lawrence, Mass.) which uses polluted water when it can get a pure supply.

Among the reasons for thinking that the pollution of the Merrimack is unlikely to decrease is the testimony of officials of New Hampshire. For example Charles D. Howard, Chief of the Division of Chemistry and Sanitation of the New Hampshire Board of Health, testified that there had been an unwritten but well understood public policy in New Hampshire, that the communities and industries of the state should not be burdened with the treatment of sewage or industrial waste. The Merrimack river has thus become a legalized public sewer. The conditions in this respect are practically beyond the control of Massachusetts as water taken from the Merrimack

would be taken out at Tyng's Island about midway between the city of Lowell in Massachusetts and the New Hampshire line.

A considerable amount of industrial waste from such factories as paper mills, tanneries, rendering works, cellulose plants, cotton mills, wollen mills, gas works, of which there are many in New Hampshire, is peculiarly difficult to eliminate from water.

It is agreed by all the witnesses that Merrimack water needs modern treatment to qualify it for drinking. The process involved was described by Mr. Jacobs and all the experts accepted his statement. The treatment of such waters consists of several processes. First long storage (30 to 90 days in a large reservoir), next aeration, then chemical treatment for coagulation, then filtration and chlorination. Water is aerated by throwing it into the air or running it over falls or rapids. Chemical treatment for coagulation consists in adding lime and sulphur which form a hydrate that attracts both bacteria and particles. It also is useful to improve color. Filtration involves a separate reservoir or set of reservoirs in which water is passed through gravel and sand. Finally the water is chlorinated and stored for delivery.

Every expert agreed that by treatment on the general lines indicated the Merrimack water could be made hygienic.

The first and one of the most important objections is that these treatment processes introduce a human element subject to all the weaknesses and failures of human nature. The experts who spoke for Massachusetts gave instances of disastrous breakdowns in such processes in the past and stressed the danger, although small, involved in every elaborate system of water purification. The witnesses for Connecticut put less stress on the possibility of failure in the purification operations, but all of them with the possible exception of Professor Winslow

stated that where two sources are equally available, one polluted the other clean, the clean water ought to be chosen.

The Connecticut experts except Professor Winslow expressing preference for a supply of pure water over a polluted supply, also said that public opinion has to be considered and sometimes is controlling; that is that a settled opinion (it may be prejudice) is to be regarded. Professor Winslow said that as a water expert he would take no account of public opinion or prejudice, confining himself on the contrary to the bare question of the quality of the water ultimately offered the consumer. The experts called by Massachusetts in addition to expressing the most decided opinion in favor of securing pure supplies of water wherever possible, agreed that considerable weight had to be given by engineers, by water boards, and by municipal authorities to any general and settled public opinion. Morris Knowles of Pittsburgh, senior member of the firm now employed by Connecticut and proposing Merrimack water, was employed by the city of Lawrence in 1917 to recommend supplies of water and in this letter to the city said this:

> "As a source of water supply the Merrimack * * * is grossly polluted now, and will probably continue to become more polluted as time passes. Under present conditions its purification is incomplete and is attended by certain lapses, which at numerous times in the past have reached a disquieting if not a dangerous stage. Although this supply can be artificially treated and purified so as to be perfectly safe to drink, the weight of disfavor against the stream as a source of supply has become so great and so real as to actually obliterate any economy in its use.
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> We therefore recommend that the Merrimack River be abandoned as a source of water supply for Lawrence."

Taking of water out of the Merrimack must be by pumping. The water is to be pumped by two pipes to Foster-

Martin pond reservoir, and if combined with the Ipswich to an Ipswich reservoir, and then pumped to the delivery reservoir Spot Pond. Much testimony was devoted to cost of the proposed supplies from eastern Massachusetts compared with the cost of the Swift-Ware development. So far as cost is concerned there is no vast difference between the schemes and any of them is within the means of Massachusetts. Every scheme proposed for taking from the eastern part of the state involves pumping and other works which are subject to considerable deterioration and some possibility of breakdown. In every estimate of cost the largely increased operating expenses of the alternative plan were capitalized to make a fair comparison with the Ware and Swift enterprise, where depreciation and operating costs would be very small. The Ware-Swift enterprise consists mainly of a tunnel and an enormous reservoir. The water moves entirely by gravity. The possibility of breakdown in such works is practically nil and the depreciation negligible.

The Merrimack is a small river compared with the Connecticut. 200,000,000 gallons a day would be about one-quarter of its daily low stage flow. There are large factories at Lowell and Lawrence, a little below the proposed take-out which it is claimed would be extensively damaged, or possibly put out of business, by the proposed diversion. The owners of these factories were not witnesses and the testimony of the engineers who were examined is in conflict as to the extent of this damage. The testimony does not enable me to make a definite finding thereon but I think there is a probability of this damage turning out to be serious to the existing factories and future factory operations at Lowell and Lawrence.

The Merrimack is a navigable river from Haverhill to the sea. The United States has a right as I think to regulate such

a diversion at Tyng's Island as is proposed. What the Secretary of War would say about it I cannot predict. Some of the experts called by Massachusetts took the view that the Secretary would certainly materially diminish the 200,000,000 gallons a day proposed to be taken. They say the Secretary of War doubtless would restrict the diversion on the same principle he applied to the Ware and Swift, namely, by limiting the diversion to flows in excess of .6 of a second foot per square mile of drainage area. I have no means of finding what the Secretary would do, but I think the navigation is important enough (and there are projects to improve it) to justify the conclusion that 200,000,000 gallons a day cannot with certainty be taken by Boston at Tyng's Island.

On the assumption that the Secretary of War would cut down the proposed diversion of the Merrimack at Tyng's Island on the basis suggested by the Massachusetts experts, a plan was presented (defendant's exhibit 25) for combining some diversion of the Merrimack with Ipswich river water in two reservoirs at the Ipswich shown on the exhibit. This plan was designed to produce from the Merrimack and Ipswich combined 191,000,000 gallons a day, the same as the Ware-Swift plan.

I think it apparent from the facts before stated that the effort of Connecticut to prove good and sufficient supplies of water in eastern Massachusetts, in spite of the decision of the Massachusetts legislature takes us very far afield. It is certain that the supply in northeastern Massachusetts of pure water is perilously near exhaustion. It is clear that the Metropolitan District cannot reach out and lay its hands on northeastern Massachusetts supplies without regard to the whole population which must obtain water from one source or another. Connecticut in this respect is calling on the Supreme Court of the United States to determine how much water supply is now

available and will continue available for a long period of time for the inhabitants of the whole northeastern part of Massachusetts; to determine how much of this water is fit for human use and will remain so for a long period of years; to say how much of it ought to be fitted for use, involving cost and expense of fitting reasonable to be imposed on the public; and to divide the supplies among the towns and cities and other communities of the region.

These questions are engineering and governmental and much fitter to be decided by the cities and towns concerned than by any court. But the questions are only suggestive and whoever passes on them will be taken still farther afield. For example it appears in the evidence that the city of Lawrence, Massachusetts, is the only town using Merrimack water for drinking. The result is a most extraordinary sale of bottled water in Lawrence. It is delivered generally like milk. 1916 statistics showed that the amount of money paid in Lawrence for bottled water was 55 per cent of the total amount paid for public water for all purposes. To force people to bottled water is not conducive to the public health. Such facts as those about Lawrence also show a reason why public opinion ought to be regarded in selecting water supplies.

It seems to me that in determining a water supply due regard must be given to public opinion. Undoubtedly the Ware and Swift acts expressed the settled public opinion of the Boston District and of the state. Up to now the Metropolitan District has been using waters of fair purity; at least waters that have not yet required elaborate treatment to fit them for drinking. The people of Massachusetts are not accustomed to fitting by modern treatment badly polluted waters. It is natural that such people should have a peculiar hostility to polluted water. Our governments in the long run are controlled

by public opinion. And while an expert on water, acting in a strictly professional capacity, may say that he will disregard public opinion, municipal and other governments cannot take that stand. The courts it seems to me cannot close their eyes to the necessities imposed by public opinion on governments. Having found on the first branch of the case that Connecticut will not be substantially and seriously injured by the Ware-Swift diversion and the people of Massachusetts having made their decision in favor of the Ware and Swift, conceding that it is open to Connecticut to ask this court to overrule the Massachusetts determination and relegate Boston and the Metropolitan District to the water supplies in the eastern part of the state, certainly the burden is on Connecticut to make a peculiarly clear and conclusive showing. I content myself with finding that no such showing has been made. Giving the proof of Connecticut the utmost weight it no more than raises a doubt. The objections are too important and too many to the water supplies of northeastern Massachusetts to warrant a decree that Boston and the surrounding district are bound for the present and during the future to rely on the polluted waters of the Merrimack for drinking water.

On this branch of the case I have quoted from Mr. Barbour and Mr. Fuller, two of the Massachusetts experts in order to give a fair illustration of the defendant's testimony and have tried to state fully their contentions, without intending to find that these contentions are right and the Connecticut witnesses wrong.

It seems to me the court upon the evidence given cannot undertake to administer the internal affairs, including water supplies present and future, of northeastern Massachusetts.

I find the taking from the Merrimack ought not to be imposed upon the Boston District. Because first the water is a polluted

water and Massachusetts has no adequate control of the pollution or adequate remedy to cure it; that the water is of quality much inferior to the Ware and Swift and the proposed project inferior from an engineering standpoint to the reservoir and tunnel which the Ware and Swift development involves. I find that the two reservoir sites, Foster and Martin's pond and Ipswich site are much inferior to the dam site at the Swift. The bottoms of these ponds are partly marsh or peat and some of the inclosing walls are of great length. I think there is danger that the proposed abstraction will work an important and undetermined damage to present and future factories both at Lowell and Lawrence. I find that the proposed take-out is of such a large part of the river flow that a substantial reduction of it by the Secretary of War is probable. I find generally in respect both of the Merrimack diversion and the 15 watershed plan that the waters for the most part are polluted and require substantial and extensive treatment by some or all of the modern methods and that in many ways it is most advantageous to obtain a source of pure supply wherever reasonably possible.

III.

(a) I have not gone into the comparative cost of the various projects because I think it is immaterial. There is no such wide divergence in cost as to make it a determining factor.

(b) I have disregarded entirely, because it seems to me immaterial, a large amount of testimony on another line. It was contended by Connecticut that the Ware and Swift scheme was simply an entering wedge to the drafting of added waters in the future from the Connecticut valley; and proof was offered of previous proposals in Massachusetts reports and documents to take water from the Millers river and other Connecticut

tributaries. It was sought to prove that the tunnel from Wachusett to the Ware and beyond to the Swift was larger than necessary to carry the 191,000,000 gallons a day and that this must be for the purpose of taking added water in the future. I disregard such evidence altogether as it seems to me immaterial. The Massachusetts legislation confines itself to taking certain waters from the Ware and Swift. The Secretary of War has imposed additional limitations. Massachusetts says she intends to divert no more water than the Secretary of War permits and in every way to follow the conditions he imposes. It is true that counsel in this case cannot control the future action of Massachusetts. But it is sufficient for this case to say that injunction should not issue against something merely feared at some indefinite time in the future. Injunction issues to stop present injuries or those presently threatened. The judgment in this case, if it goes in favor of Massachusetts, should settle her right to take only so much water and in such manner and at such times as the Secretary of War permits. It will in no way bar or diminish the right of Connecticut to proceed against the taking of additional future water. For this reason I disagree with the suggestion advanced by Connecticut on the hearing, that she is entitled at least to an injunction restraining Massachusetts from taking any more water than the Secretary of War has authorized. As there is no threat on the part of Massachusetts to do that, such an injunction does not seem to me proper.

(c) It may be suggested that Massachusetts has lost rights which she otherwise might have had by having herself allowed her eastern waters to be polluted; and that she cannot profit by a necessity for Ware-Swift water which she herself has created. This is not the case of a plaintiff coming into equity where he must come with clean hands. But perhaps the principle of

coming in with clean hands may sometimes be applicable to a defendant. If Massachusetts were grossly at fault in polluting her eastern waters so that they were unfit for use and that was the only thing which created the need for Ware-Swift waters, I should feel she might be held to pay the price of her own wrong-doing.

However, her practice has not been different from that of Connecticut and other New England states and it is a matter of notoriety that it is not different from the practice which has prevailed on other rivers and in other parts of our country. The pollution of our country's rivers makes a pitiable record. I think Massachusetts should not be penalized in this fashion for following a practice which has been almost or quite universal in the United States. It is to be noted too that the more important supply, the Merrimack (the other supply being at best insufficient), is polluted in major part by New Hampshire population and factories.

(d) It seems to me the decree should be; dismissing the bill with a provision that if (say within ten years) a dam at or near King's Island on the Connecticut is built to develop substantially 50,000 horse power, Massachusetts pay the owners of such dam and power the sum of $80,000.00.

CHARLES W. BUNN.

FOLD-OUT IS TOO LARGE TO BE FILMED